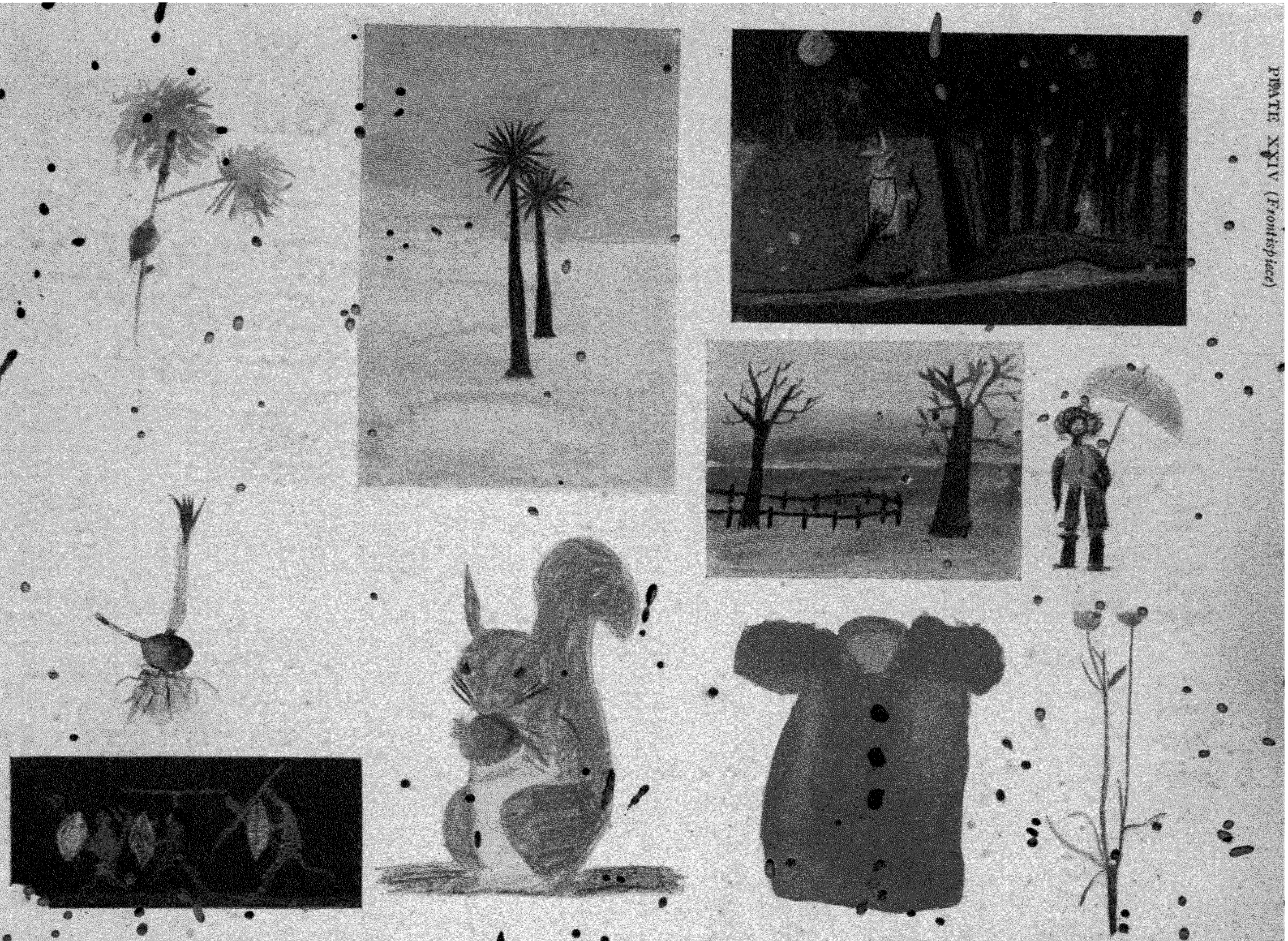
THE BOOK OF
SCHOOL HANDWORK

PLATE XXIV (*Frontispiece*)



COLOUR WORK DONE BY CHILDREN BETWEEN 6 AND 7 YEARS OF AGE

THE BOOK OF SCHOOL HANDWORK

AN ENCYCLOPÆDIA OF EDUCATIONAL HANDWORK SUBJECTS, METHODS, MATERIALS, TOOLS, ORGANISATION, ETC.

Written by the Leading Authorities on, and Leading Teachers of, Handwork in the British Isles

EDITED BY

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THE BOOK OF SCHOOL HANDWORK

XLIII. CLAY-MODELLING FOR INFANTS

By MISS AMY WALMSLEY

Principal of the Froebel Training College, Bedford.

Clay-modelling for Children under Eight Years.—"Good thoughts are no better than good dreams unless they be executed," says Emerson, and this suggests a sound reason for teaching clay-modelling to young children.

There is no need to enter in detail into the psychological grounds for giving clay, plasticine, or similar material daily to young children. It is the material, *par excellence,* for expressive work. When given in the right condition, it calls forth gentle muscular activity, both hands are used continuously, the idea of form is developed through the sense of touch, the child is able to express his own thoughts, and in every way that intimate connection is being made between hand and brain of the little worker which plays such an important part in the all-round development of the future man or woman. In the following paragraphs I have tried to suggest various ways of taking this plastic work with children.

Aims and Work for Children Aged Four.—For this age both plasticine and clay should be supplied—the former used daily for expressive work, the latter when large quantities of material are required, also when the little ones are making something that they can take home.

An ordinary onlooker watching a group of children of this age at work will notice the enormous amount of energy they expend, pounding their material on the board, rolling it up and down, making something and a moment afterwards destroying it with the greatest delight; the creation has satisfied their activity, and the capital shot which destroys the whole edifice calls forth a peal of laughter containing no note of remorse that work, which had taken time and pains to accomplish, is no more!

At first no attempt is made to produce the exact form which the children wish to indicate—a lump of clay here, another there, suffices for a house or a man—but the number of lumps must be correct. Not that the children count, but, from queries and criticisms of their playmates, such as "Where is your man?" "Where is the tree?" "You haven't made your doggie!" etc., we gather that children have a clear notion of what they all want—viz. to see the "something" indicated rather than to get the correct form. They do not *count* the number of objects, but they are conscious that all are not there. Incidentally this can be made use of for number work.

Illustrating Stories.—The story of Henny Penny was told to a group of four-year-olds, all boys. The birds mentioned were familiar to them. The boys followed the story with keen interest and asked if they might make "Henny Penny, Cocky Locky," etc. Plasticene was given, and all members of the group proceeded to indicate by various shapes the different birds. No attempt was made to obtain anything approaching the right shape, but all the children *named* the different pieces in correct order, the most interesting result being one which indicated the size of bird as well as order. The following drawing gives the shape

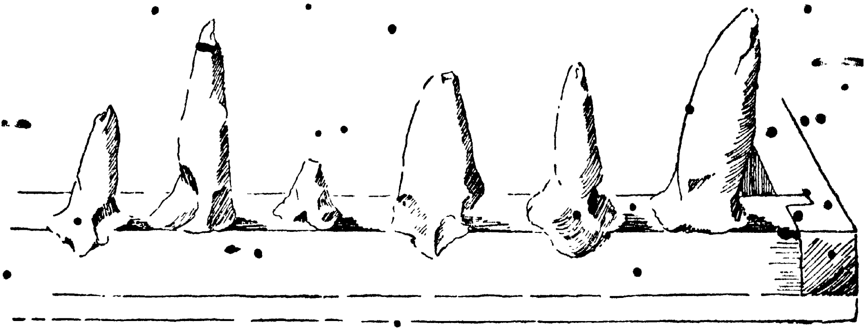


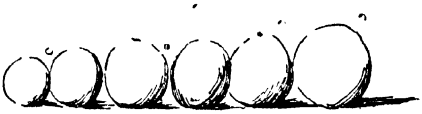
FIG. 1.—HENNY PENNY, COCKY LOCKY, ETC

of the pieces of clay as placed at the edge of the tray (we use zinc-lined trays for plasticine work), as well as the heights of the different birds.

Simple stories which lend themselves to numerical ideas are, *e.g.*, the well-known Three Bears with its unconscious emphasis on "three," and Epaminondas (the six tarts). The idea of equal weight when the little ones weigh their pieces of plasticine to make bricks "just as heavy as one another." Idea of distance when the sixpence is placed *near* the stile but a *long* way from the house. *Many* eggs in the Old Woman's basket, "none" left, or only "one," and so on, etc., etc.

Connection with Number Work.—Just how much number work should be introduced in connection with stories is a debatable point. Normal children delight to count and little ones can be made familiar with the counting of objects through play. When we find children saying, "I'll make three balls," "I'll make two," etc., it is time to lead them on to the next point.

Connection with Colour Work.—Making of beads of different sizes and the use of the terms large, larger, largest, or small, smaller, smallest, etc. This is one of the few models that small children may, in my opinion, be allowed to colour, the choice of colour and the arrangement of the differently coloured beads being a helpful occupation from both children's and teacher's point of view. The children have freedom to use the colours they most enjoy, and also the pleasure of colouring one or more of the same colour and arranging the beads accordingly. The teacher gains much knowledge of the individual children by observing the choice of colour and the final arrangement of their beads.



SIZE

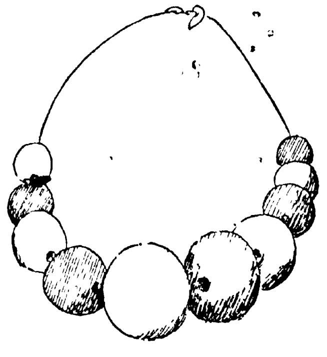


FIG. 2.—COLOURED AND PLAIN BEADS

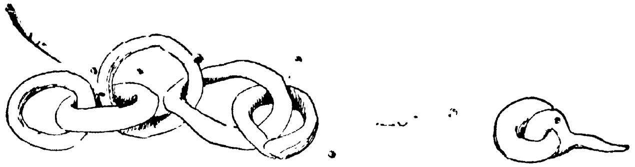
As a rule I do not advocate for young children the use of colour in connection with modelling. The colours put on are crude and not at all natural. They detract from the "form" and often render the work inartistic. The vivid greens and hard reds and yellows are bad, but when enamelled pears and apples are shown with pride as artistic productions, one wonders what artistic standard the teacher possesses. When pottery is taken with older children, colour may be used for decorative purposes, but not for natural objects.

Nursery Rhymes.—As the little ones pound and roll their clay, usually chattering at the same time, they love to work out their ideas connected with simple stories. Plate II. shows the result of four little people's representation of Humpty Dumpty. During the work a request is made that some one's special favourite nursery rhyme or story may be worked out next day. It may or may not be known to the whole group. If not known, it soon becomes, without any *teaching* on the part of the kindergarten, the possession of those who possessed it not! With "Oh! don't you know?" repetition follows; the little fellow workers listen eagerly, the narrator is not satisfied with one narration, but goes through the rhyme again and again, the others join in and proceed to carry out their own ideas in clay.

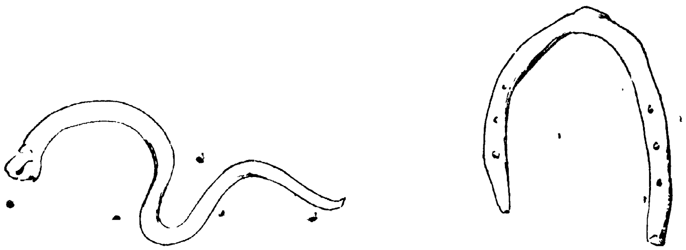
Much insight of the child mind is gained by the kindergartner as the children explain the reason "why" of their creations to one another, *e.g.* when one small boy asked another, "Why have you not put a roof on your house?" he received the answer, "If *I* had put a roof on, *you* couldn't have seen the man inside!"

Some teachers object to clay for small children because it dries and cracks so easily. If damp sponges are provided, the little ones can manage quite well.

Measurement.—A favourite play with plasticine is to roll it out as much as possible and then to twist the roll into various shapes. Many useful suggestions come from the children; they love to imitate one another. To take two examples: (*a*) one child made two links of a chain, which appealed to the rest of the group so much that soon all the members were trying to make chains. The kindergartner, too, was busy with her plasticine. When she held her chain up, the little ones were struck by the evenness of the links; in a moment their chains ceased to exist and they began to roll and *measure* the length of coil before twisting it round, in order to obtain the same result.



CHAIN (FROM MEMORY). BASIL, AGE 4 SCREW (FROM MEMORY)



SNAKE HORSE SHOE. GORDON, AGE 4

FIG. 3

Here I may say that, just as the little ones should hear good, simple music, so they should see their own ideas worked out in an extremely simple, artistic way to help them to develop. This help, as a rule, they do not receive.

(*b*) A child tried to make a wheel, but was not succeeding very well when a milk-cart passed by. The Babies'-room window is low enough for the children to look out and see all the wonderful and fascinating things that pass by. One fleeting glimpse unlocked the memory door, and spokes soon appeared where only a solid piece of clay (primitive wheel) existed before. Soon there was a glorious wheel—imitated by others—and before long many new words were *asked* for and made part of the worker's vocabulary: "Miss ——, what is this called?" etc.

The necessity for a unit of measure may arise spontaneously even in the Babies'-room, when, for instance, Hubert, intent on making the railings which he can see from the window, exclaimed, "I must measure them to see if they are all the same size" (meaning length, thickness being of no account: see Fig. 5). John, when making the spokes of the wheel, likewise discovered that

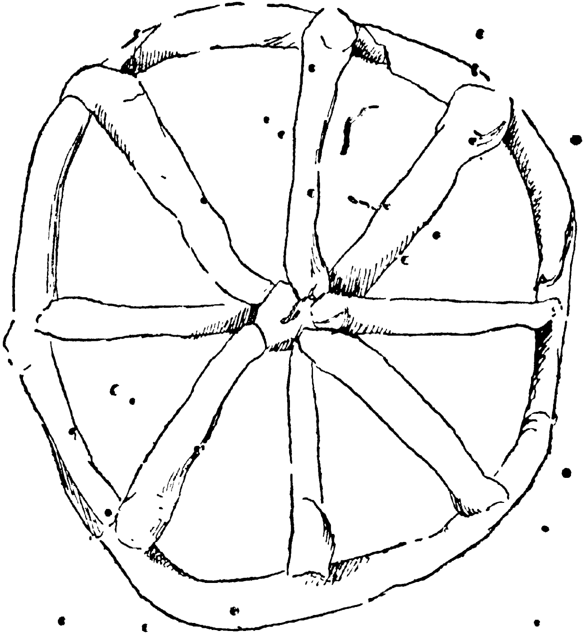


FIG. 4.—WHEEL. JOHN, AGE 4

"he had to measure." Naturally he made use of the word that Hubert had used, he also proceeded to "suit the action to the word." Gordon was content to use two knives and cut up a nice long roll of plasticine, which he had rolled out into smaller pieces, saying nothing, but measuring by sight.

The above examples suggest definite work which may be taken with a large class of babies. The rolling exercise is excellent; a certain size stick may be chosen by a child as the unit; sticks may be distributed to the children, and all the children may make

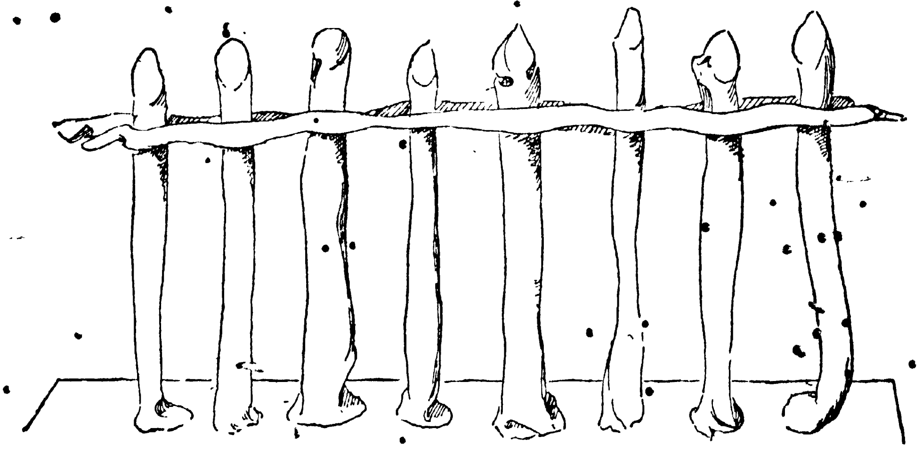


FIG. 5.—SCHOOL FENCE. HUBERT, AGE 4

two or more rails which they can place upright and so form a railing as a piece of "group-work." They can bind the rails together by a cross bar, and may get over the difficulty of making holes in the same way as Hubert did. (See Fig. 5.)

The children suggest the path of interest; the kindergartner *guides*. Later on the same play may be used in language training: instead of printing the words, the children can make them in plasticine, and also model the object for which the word stands—a much more fascinating play than even drawing.

Aims and Work for Children of Five Years.—The method used by five-year-old children to produce a natural object in the solid is usually to roll the clay into a ball and then press or pinch the clay here and there until the required shape is obtained. They grasp the idea of the general form and leave details severely alone, which is the first thing we desire in good work. If an apple is produced, it is usually a sphere with an indentation in which a stalk, often a most substantial one, is placed. Opposite the stalk a small piece of clay may be plastered down to represent the sepals. This is good for a beginning, and many objects may be treated by the children in this way, either from memory or the natural thing.

Developing the Habit of Careful Attention.—But as time goes on the children should be guided wisely to observe the natural object a little closer, to feel it round and round and all over, "many, many times"; and so unconsciously to gain the power of clear observation and better representation. Merely a suggestion or a few moments' attention to one particular point each time modelling is taken will lead the children to develop a habit of *carefully noting differences or resemblances*, and thus enable them to lay the foundation of a habit of thought which will be of inestimable value to them in their later studies. Some children are more attracted by differences, others by resemblances; it does not matter which, but it does matter that through their absorbing play they are laying the foundation upon which much future work must depend. How many adults have never been guided or required to perceive resemblances and differences. The result is they do not "remember correctly, judge soundly, imagine truly."

It is quite sufficient to ask for concentration on the particular point for a few moments. Take, for example, the difference between the stalk of the pear and apple, two well-known objects. The teacher deliberately ignores the shape and concentrates, for a few moments in that particular lesson, the children's attention upon the stalk *after* they have made their models. The children are not confused, and will usually in future pay attention to "stalks."

Or again, the class have decided that they wish to make tea sets, either collectively or individually. One point here, in one lesson, is obviously *relative* size—that is quite sufficient. The shapes of the various articles should not be criticised. Another time the shape of the cup, plate, etc., might be taken. The principle of the old adage, "One thing at a time and that done well, is a very good rule, as many can tell," will help a child to rise to greater heights in any subject than we are aware of. It is confusion of thought that blocks progress in any subject, and this is due to too much being attempted at once. At the other extreme we have free expression run riot with no guidance whatsoever, leading to a slovenly mind and no power to do well. Children work very quickly, and therefore there is ample time for a few moments of concentrated attention, and many minutes for free expression.

Modelling from Nature.—Plate I. shows a group of three children (aged five) just completing the modelling of their own particular hyacinth bulb which they have cared for since last November. The small glass jars are easily obtainable and make the work of greater interest to the children, inasmuch as the first step is to make a bulb to fit the jar, *not,* as in the autumn, find a jar in which to fit the bulb. In this lesson the bulb was first modelled; then the flower-stalk and buds—although the children knew that the leaves were first seen; then the leaves placed round to protect the flower; and, last of all, the roots were modelled. All the children worked the same way, possibly imitating one another. This and similar lessons could be taken with classes.

When the children are studying their twigs at the beginning of the spring term, they may be asked to model them in plasticine. Here, this medium is better than clay, for the children can manipulate it more easily; and as the models do not shrink, they may be kept and compared with the originals in a few weeks' time and

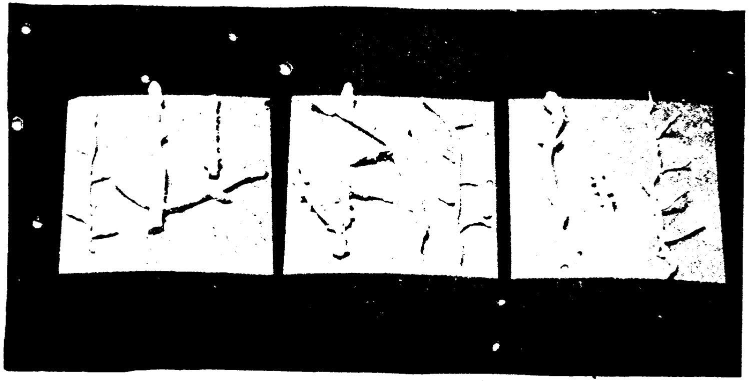
"OUR HYACINTH BULB." CHILDREN AGED 5

MODELLING FROM NATURE. FREE CHOICE. 6 YEARS

S.H.

PLATE II

FREE EXPRESSION HUMPTY DUMPTY.
CHILDREN 4 YEARS OF AGE



COMPARISON OF BUGS IN WINTER

MILK MUGS. FIRST ATTEMPT

MILK MUGS. SECOND ATTEMPT

difference in growth of buds noticed. The remarks made by the children will soon convince any kindergartner of the value of such a piece of work. Plate II. shows three specimens of such work by children aged six years.

The Sense of Power.—After an experience like this the children will be able to brushwork their twigs; and also, when asked to draw them from memory, they will be able to give the chief characteristics. What seems to me to be a most important part of this is their delight and joyousness in representing something which they "know they know." That feeling of power which leads to the highest creative work of man is discernible in a little child, and should be encouraged to the utmost.

Unnatural Work.—A point that I should like to emphasise in connection with the modelling of natural objects is the most unnatural results obtained when the children are in the hands of an unsympathetic or (as regards modelling) an ignorant teacher.

Some children get nearer the heart of things than some teachers and are capable of appreciating Mother Nature more than one would think. If in Nature Study more real nature work was done and the children realised some of the simple laws of growth, they would not at the age of seven years model a carrot with deep, sharp scratches on it and they and the teacher be content with such work. That this is done so often indicates that both the nature teaching and the clay-modelling work are at fault. The child has not realised in the slightest the mode of growth of the carrot, which involves a struggle in its earthy bed, and therefore the clay model is nothing but a cylindrical lump of clay with a few scratches on it. The question seems to be: How much does the teacher realise?

When an instructor told a student, who had been studying at a School of Art for three years and had passed several examinations in modelling, and who was then studying clay-modelling from the child's point of view, to think of the life of her natural model and then try to express the inner life of the natural form in her clay model, the student exclaimed, "I have studied clay-modelling for three years, but I have never realised what it meant until now." The use of casts, etc., in Schools of Art may be responsible for much lifeless work.

Things to Model.—What the children are to model at the different stages it is scarcely necessary for me to enumerate in detail—" the world is so full of beautiful things." The children will model any and every thing from memory. If the kindergartner makes the choice, she should see that it is really a " beautiful thing" that she puts before the child. Let them have Nature at first hand. Give only such things as are within the capacity of the child. At first bold, simple, natural forms.

One writer says: " We must inoculate them (the children) with the desire for beauty through the real, living forms of nature. Then, later, we can expect some result when they come in contact with the great works of art, the thoughts of great minds expressed in concrete forms. It is useless to put before their eyes the perfection of Greek art unless we first give them the hunger and thirst, the vital love for beauty as it is exhibited in every natural flower, leaf and shell and in various living forms that attract and fascinate the young."

Many kinds of fruit, such as apples, oranges, pears, plums, cherries, etc., are suitable for modelling. Avoid using bits of string or the real cherry stalks when modelling cherries. Why trouble to model the cherry at all if the children may not attempt to model the thin stalk and thus obtain some knowledge, however intuitively, of delicate strength? When taking such objects as carrots, radishes, turnips, etc., try to obtain at least one specimen showing the whole of the plant. Some town children gain far too many erroneous ideas of plant life because they never see anything but parts of a whole. When the *whole* can be brought before the children, let it always be there; then a *part* may be *chosen* for the purpose of modelling.

The general method for all lessons is the same, and is based on three factors. Firstly, see what the children can do entirely by themselves. Secondly, study or observe the natural object, and later compare it with the model made. Thirdly, let the children try again. If any children show decided artistic ability, always provide something special for them—that is, take care not to starve or suppress strong individual power by lack of thought or the taking of a little extra trouble.

This method is used when part of the time is going to be taken for training. When the children are at work which is purely imaginative, or their interpretation of a story, then when the teacher has provided tools and materials she has done her part and need only be a sympathetic listener. If the development of the powers of the children is proceeding on the right lines, she will be able to note at the end of three months a decided advance not only in power of expression but also in technique.

All kinds of shells are beautiful: mussel, cockle, whelk, snail, etc. In the autumn all England is so full of colour that all available money and time should be spent on trying to catch some of the beauty of Nature in that particular direction, by brushwork.

Modelling Flowers, Leaves, etc.—With plasticine or similar material the children like to model flowers and leaves. They form each petal separately and then put them together. Clay is unsuitable for this work, as it soon becomes brittle and easily cracks.

Plate III. shows a tulip modelled by Cynthia, aged six. She may be seen at work in Plate I. The arrangement of the boards is her own. Marjorie, just seven, shows what can be done with germinating beans, peas, wheat, as models (Plate III.). Grown in glass bottles between damp blotting-paper and the glass, they form good studies, but as Marjorie pathetically remarked, "I could do better if I could touch them!" For spring studies growing bulbs are very satisfactory. In most schools, town or country, they are usually grown in the infant-rooms, and can be modelled at the different stages of growth. Twigs of all sorts are easily procurable, and if kept in water will result in an indoor spring room, although the weather may not be spring-like outside. Avoid all *small* work for little people: a single tulip is good; a snowdrop is somewhat unsuitable—it is too small.

A Typical Lesson.—Plate II. (the piece of ribbon fern) suggests an excellent lesson that may be taken with a large class of children, the study of which might proceed in the following way. It is taken for granted that the teacher cannot supply each child with a piece of fern. A ribbon fern should be in the class-room for some days before the lesson, and the children told to look at it so that they may be able to model some of the fronds. Before the lesson pin up a frond with a white background on the blackboard. If the class is very large, two or three blackboards should be used, so that all the children in the class may see at least one frond clearly.

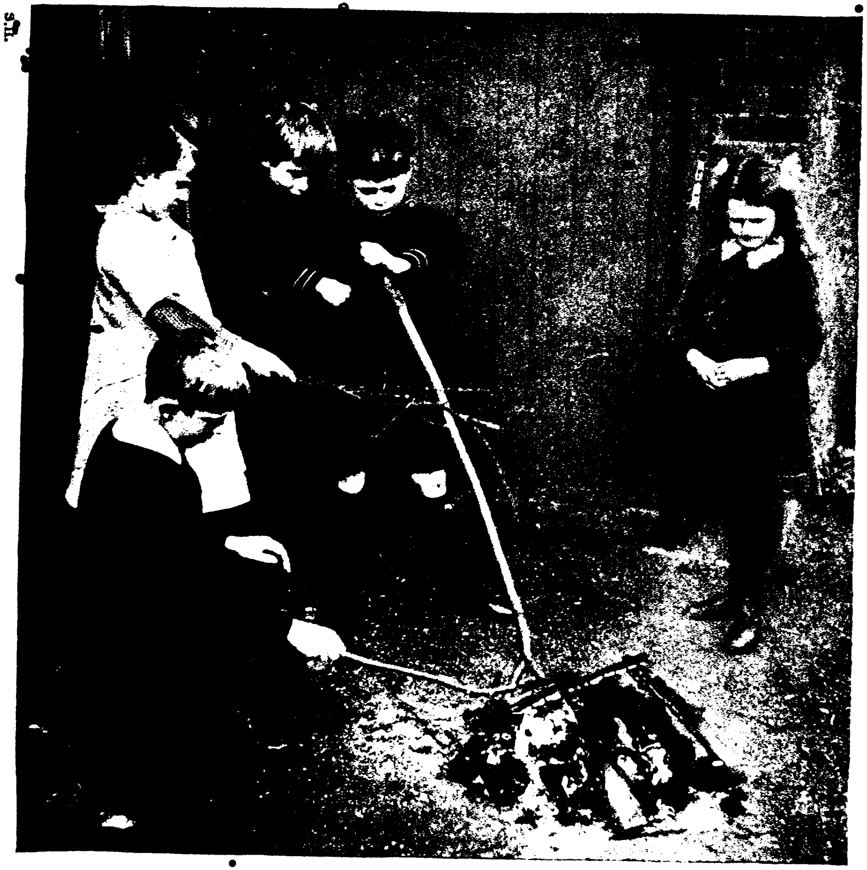
Let the children make an attempt with their modlex or plasticine. The majority will have made their fronds too thick and heavy. A few moments' examination of the real frond will reveal "the beauty of lightness." Suggestions as to how to obtain this should be received from the children, and, if good, acted upon. This feeling of lightness or delicacy is so necessary that if good suggestions are not received, it may be permissible to give directions so that the children may use the knowledge on future occasions. By rolling out the plasticine they may obtain the thin stalk and place it in position. By rolling out more plasticine and pressing it down between thumbs and fingers of both hands the children obtain a ribbon-like piece of plasticine which they can easily bend and place in the position required. This exercise is useful in the representation, at this age, of grasses, rushes, petals of flowers.

Free Expression Work.—This is a phrase which has been heard on the lips of all educationists during the last few years. The result of free expression work without guidance has resulted in a deplorable state of affairs in a certain large boys' school in connection with drawing. The same can be said as regards much of the clay-modelling seen in schools. Either the work is too mechanical or the children are allowed absolute liberty without any guidance whatever. The result is little or no true progress is made in either case. Practically no originality, no initiative, no resourcefulness, no development take place in the first case. In the second, a child here and there with a special gift for form does make progress on account of the liberty accorded, but even he might go much farther with the right kind of guidance.

Making Mugs.—Plate II. is an example of a piece of work done by a group of ten children, aged six, who had not handled clay before. Their milk mugs were given to them and they were asked "to model the clay." Beyond that statement no more was said, and the children were free to work in their own way. The following points were noticed:

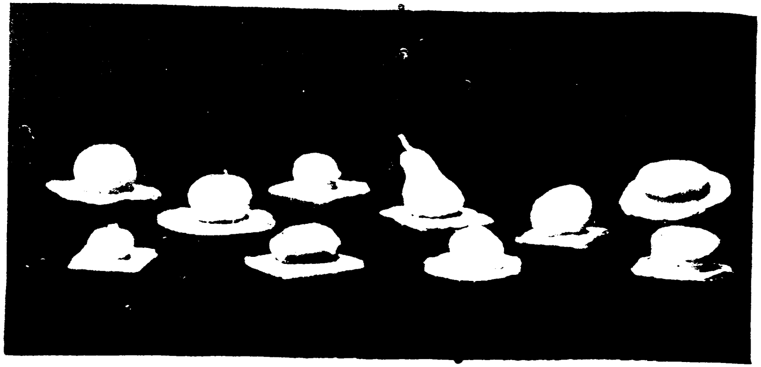
1. Not a single child touched her real mug.

PLATE III

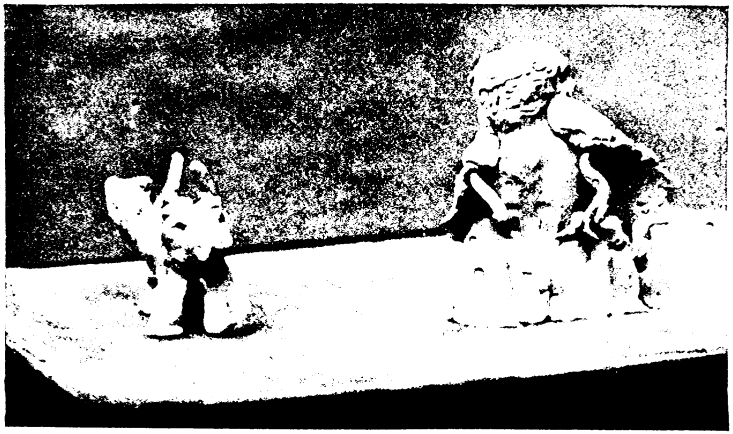


SHOWING FIRE IN WHICH POTS SHOWN WERE BAKED; ALSO SOME OF THE MAKERS OF THE POTS. CHILDREN AGED 7

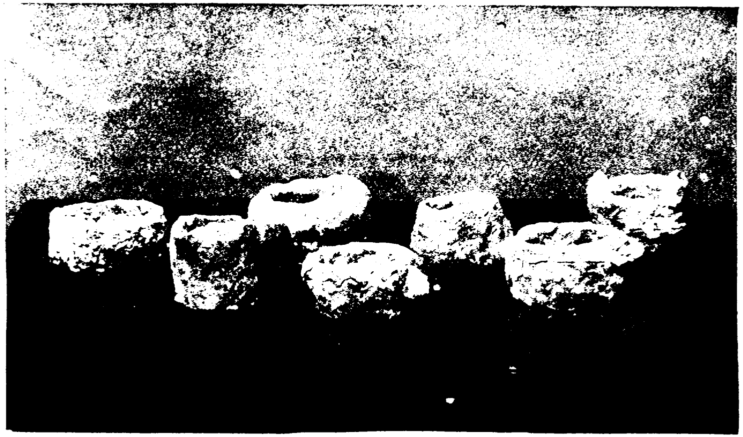
FROM NATURE



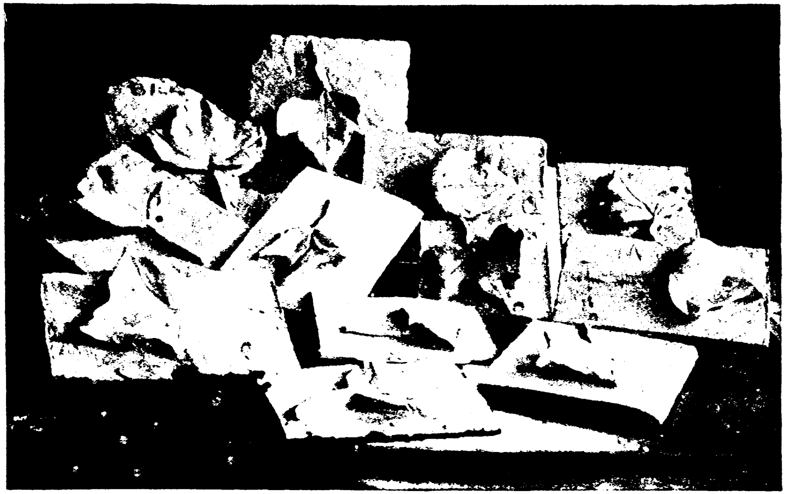
SECOND ATTEMPT AT MODELLING IN RELIEF



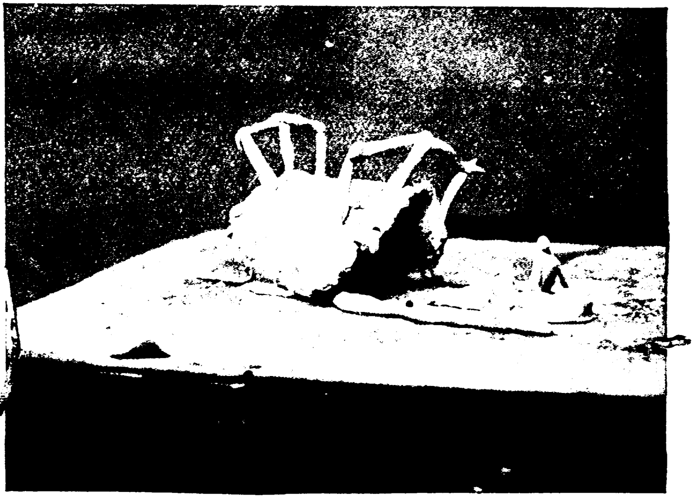
FREE WORK. RED RIDING HOOD AND THE WOLF. AGE 5 YEARS



PRIMITIVE POTTERY



IVY LEAVES FIRST LESSON IN RELIEF MODELLING



FREE WORK. TIN SOLDIER SAILING DOWN THE GUTTER. PADDY AGE 6

2. All began by making a flat piece of clay serve for the bottom of the mug, and then building up the sides, somewhat after the style of the coiled pottery of primitive times.

3. They worked very quickly.

4. Eight children produced some kind of mug; two accomplished very little, and that in imitation of others.

The children's models were collected and placed on a table in front of the group. The real mugs were next handled—the children felt inside and outside, round and round, etc. The kindergartener asked the group for what the mugs were used, and when the answer was given, a child poured water into one of the clay models. It ran out of various holes. All the mugs when tested were found to be faulty. "Let us make another," was the request. It was granted. This time the children were asked to handle their real mugs as much as possible, to try to make the clay model as much like the real mug as they could.

Various suggestions were received from the children as to how the bottom could be kept flat, the sides smooth, the top even. Not one suggestion was made by the teacher. The children then began to model the mugs a second time. The result is shown in Plate II. Not a model was touched by any one save the maker, who also tried, when the mug was finished, whether it would hold water. Ten children made mugs. The comments made by the children were excellent, and no words were needed from the teacher. "I shall always feel my model," said one. "How much better my second one is!" exclaimed another, and so on.

The group had gained in *power to do.* They had also experienced the feeling of pleasure in work well done that served a purpose. I have had the same experience with other work, and hold the opinion that free expression work day after day, week after week, without any guidance, is detrimental to the development of any child; and that mechanical work is equally detrimental The true development of the child in the technique of any subject takes place when, by judicious encouragement and suggestion on the part of the adult guide, the child is led on to use his powers of attention, observation, judgment, and reasoning, so that he applies these same activities to all subjects. He develops an orderly habit of mind which will make him a useful citizen and a first-rate worker in any pursuit which he wishes to take up, whether manual or intellectual. That children should always be allowed to experiment first to see what they can do, or find out, is the right way to begin all work; but that they should be left at this experimental stage means a waste of time and a waste of power. They are heirs of all the ages.

Aims and Work for Children of Seven Years.—*Pottery.*—Children of seven may use the clay in connection with their lessons on Primitive History. The following experiment in pottery making shows how children may themselves work out the actual processes by which pots and all kinds of clay vessels were probably produced by primitive peoples. Clay was dug up from the river banks, and each child modelled his pot freely, according to his own ideas. Various forms were chosen, depending on the purpose for which the vessel was intended. Handles of twigs were added by some who did not realise what their fate would be when fired. Some crude sort of ornamentation was tried by others. No tools of any kind were used. When finished, the pots were left for some days to dry thoroughly.

The next process was the "firing." A pile of wood was collected by the children and set alight. When a good heat was obtained, some of the burning wood was raked aside and the pots placed in the centre of the pile and then covered with the burning wood and ashes. The fire was kept burning all day. The pots were allowed to remain in the hot embers until the following morning. The results proved most satisfactory, and gave great delight to the little workers. Two of the pots turned a beautiful red, one was almost black and the other four variegated.

Plate III. shows some of the makers of the pots shown in Plate IV. The pots of Plate IV. are in the fire shown in Plate III. The day was windy and the smoke was being blown in the children's faces while they were photographed.

In such an experiment as this the children should, if possible, obtain the clay for themselves from their own district. If not, the teacher should obtain it from the nearest possible district. The idea that primitive woman could buy her clay at a shop must be dispelled. From each set of children we usually obtain open bowls and plates. Very seldom is a narrow-necked, bottle-shaped piece of pottery obtained spontaneously. The necessity of having a handle for carrying purposes is frequently suggested, and naturally it always shares the same fate, *i.e.* it is burned off.

The experiment of allowing the children to "fire" their pots while still wet is always tried—result: cracked pots! The results of firing in such a primitive fashion will show signs of the smoke that has reached the pots during the process, which cannot be avoided. The black smoke on the red clay gives a rather pleasing effect, and may have been one of those accidents which led to the deliberate colouring of pots.

Making Bricks.—If the children can be taken to a brickfield to see the bricks being baked, they will realise how like the process is to the one which they have already attempted, and also how necessary it is to keep the smoke from contact with the bricks. Older children may try to build a small kiln, but with children under eight it is wiser to treat all subjects from the child's standpoints, and not to trouble them with details which they cannot understand.

The making of bricks can be done by children of seven. The fact that the same simple instruments are used in the brick-making of to-day as were used by the Egyptians of old makes the study a valuable one. Again, take the pure clay as it comes from the earth and work it up until it is of the constituency of dough, that is, will allow you to press your thumb into the mass and withdraw it without any clay adhering to your thumb.

The method of procedure is the same as in other work. The children take the clay and see what they can do with it without using tools. The modelling board on the table represents the flat, smooth ground. The necessity for some kind of a tool is soon felt, and first one and then two pieces of wood are next discovered to be useful in patting the clay into shape. The results may be fairly satisfactory, but the bricks take a long time to make and they are of different sizes.

The suggestion that the clay should be weighed overcomes the difficulty of size; but ere long the thought "it must take a long time to make a sufficient number of bricks to build a house" is sure to be expressed. If the children have been through a kindergarten and accustomed to do constructive work and make sand pies of different shapes on their sand tray, some one is sure to suggest a version of the following: "Why not press the clay into a 'mould' (shape and tin were also suggested), pat it down, and turn it out?" Observe that the child describes exactly the process of making hand-made bricks and tiles. The brickmaker does press the clay into a mould, pat it down, and turn it out!

Alas! when the child tries to perform the same action, he finds that the clay "sticks" and won't turn out. More thought given to the problem usually ends by some one suggesting that the mould should be coated with sand before the clay is put in, but this depends how familiar the children are with the properties of sand and clay in their constructive work mentioned above.

The rest is simple and the delight enormous. The children line the mould with sand, put the clay in, press it down, cut off the surplus clay with the bow cutter; add a few small pieces of clay; make all smooth and flat; dip the beater in water and run it over the top of the brick; sand the top of the brick, and turn it out on lifter. Then allow the brick to dry.

The children cannot "throw" the clay into the mould without touching the sides like the workmen do; it is too difficult. The realisation that such an apparently simple action is so difficult to perform carries its own lesson with it.

Thanks to the kindness of some friends, we have a complete set of apparatus for the above work. The drawings (Fig. 6) will show what is needed. The mould is a quarter of the size of an ordinary brick mould, and it is quite heavy enough for the children to manipulate.

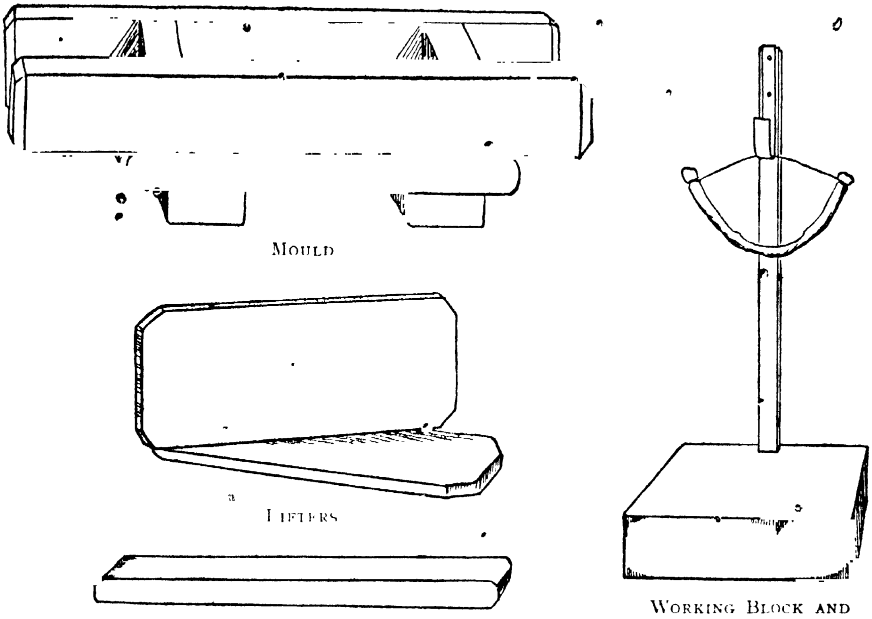
Modelling an Ivy Leaf.—Plate IV. shows the results of a first lesson on the making of a plaque and modelling an ivy leaf in relief.

This is a lesson involving direct teaching, and yet each child may show his individuality. The method is as follows:

(*a*) The teacher working in front of the class shows how she rolls a piece of clay, about the size of a walnut, and presses it on her board. The children do the same and repeat the process until they have covered a large enough surface with clay of an equal depth.

(*b*) The teacher shows the use of the straight edge for smoothing the plaque.

(*c*) The children choose their own leaves and place them lightly on the plaque so as to obtain a natural position. On no account must the leaf be flattened down *on* the clay. The placing of the leaf on the plaque I consider permissible for children of seven



MOULD

LIFTERS

BEATER

WORKING BLOCK AND CUTTING BOW

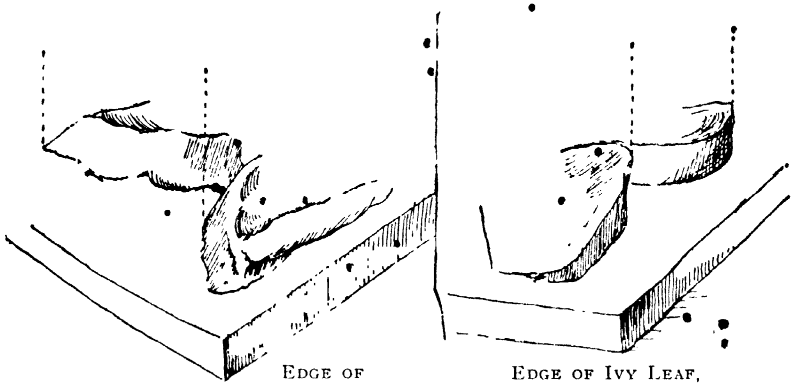
FIG. 6

years, who have not usually the power of drawing the leaf correctly.

(*d*) The outline of the leaf, as it is placed, is traced round with a modelling tool.

(*e*) The children watch the method of the teacher as she blocks in part of her leaf on her plaque, and then proceed to build up their own models. Each child must observe for himself the different heights of his leaf, and also notice the direction in which the "leaf slants" (I use the children's own expression for direction of planes).

A common fault to be found in all beginners, young or old, is the tendency to "draw in" the edge of their model. If the children are asked to put their straight edge or modelling tool perpendicular to the plaque, they will find that the edge of the



Edge of Ivy Leaf, showing Faulty Modelling

Edge of Ivy Leaf, showing Correct Modelling

Fig. 7

leaf should touch the straight edge. Once this technical point has been grasped (it is a simple one), great improvement will be shown in the work.

(*f*) The teacher demonstrates how the veins should be treated. So many children are allowed to go on year after year drawing lines on their models and calling them veins that it would seem as if many teachers had but little knowledge of modelling.

Plate IV. shows the unaided work of each member of a group of twelve children, seven years of age. This class in future will be able to work entirely by themselves until a different type of model needs to be built up, and even then the right way of dealing with the technical points may be suggested by the children.

The poor clay-modelling seen in so many schools must be because of the lack of knowledge on the part of the teacher, who cannot give adequate guidance to the little people, rather than lack of power on the part of the children.

Plate III. shows a group of models of different kinds, all built up or modelled in the same way as the ivy leaves by the same set of children two months after the lesson on the ivy leaves, no modelling lessons having been given during that time. The figure illustrates a point mentioned above—viz. that when once a "technical" lesson has been taken, the children can apply it to somewhat similar work. They all knew how to make the plaque, and began to build up on the plaque in the mass without attempting to draw an outline. Each child chose his or her model from a group of natural objects brought by the teacher. The three *sectional* models are put in to show how difficult children of seven find fine work. This kind of modelling belongs to a later stage.

Later on these children may attempt to group their objects. The children should lead and the teacher follow, always ready to guide over difficult, technical points, so that the children may become conscious of their growing power. In Plate III. may be seen two groups of mushrooms, showing the difference between the work of three five-year-old children (left-hand group) and three just seven-year-old children (right-hand group). Note differences of detail. Children of all ages may have the same models, but the method of treatment will differ. An apple may be a suitable object for a child of four and also for the greatest sculptor.

Memory Work.—This is another way of adding interest and knowledge. Each child decides what to do, works out his own ideas without comment from the teacher. When finished, the work is put away and the child is asked (during the next few days) to look at and study the actual object he has modelled from memory. At the next lesson he is asked to model the same object again, from memory; and when he has done so, his previous model is placed before him and compared with his second one. Various results are at first obtained. The forgetful or happy-go-lucky child has *not* made any observation, and this second production is, therefore, no better than the first. The conscientious child's work shows great improvement as to *facts*, although the artistic finish may not be improved. The artistic child usually shows that he has not only observed but has caught something more of the "life" of the object, etc.

The teacher is then able to deal with the individual child according to his needs, and thus promote true development, which will show in all other work. The training of the powers of the mind through the senses, and particularly at first through the sense of touch, is true education.

Time Models.—These, though of greater value with older children, may be used occasionally with advantage with younger ones, particularly if the class as a whole is not alert. Either the object may be given or mentioned (memory work), and the children told that they will have fifteen minutes in which to make it. Here, again, the teacher has nothing to do with the modelling, but should sit quietly and make practical observations for future use. She notes the weak or clumsy fingers; the attention that wanders from the maker's own object to that of a companion's; the worker who wants to tell another how to make his, but is not anxious to finish his own, etc. Different types of embryonic men and women present themselves to her, and if she is wise she will note in her private journal the characteristics of her little ones.

Materials.—The material used for modelling for children between four and eight years may be various preparations of plasticine, wax, or clay. The need of such material for young children is now taken for granted, and we have no difficulty in obtaining some kind of preparation, but none seem to adequately take the place of the potter's clay.

Potter's clay can be obtained from any pottery works at about 5*s.* per cwt., but to this must be added 1*s.* for the cask in which it is sent, and the cost of carriage, which is 1*s.* per cwt. within a radius of fifty miles of London. Londoners can obtain their clay from within their own city. The clay is sent ready for use, and if ordinary care is bestowed upon it, there should be no difficulty in keeping it in good condition.

The clay is best kept in an air-tight wooden box. A damp cloth spread over the top of the clay will keep it from hardening.

All clay left over from each lesson should be worked up and put back in good condition. There is no material that pays so well for a little attention at the proper time as clay. A few minutes spent upon it after a lesson to see that it is put back in right condition will save many an hour's work later on, which must be given to it if the clay is allowed to get hard.

If the clay is dry, it must be broken up, water poured over it, and allowed to stand until the clay has absorbed the water. How to proceed depends upon the quantity of clay to be worked up. If a large quantity, it is best to put it on an old slab and beat it with a piece of wood. Naturally one must choose a place in which least harm can be done to the walls and floor, as the mixing of clay is not a cleanly piece of work.

A smaller quantity can be worked up in a bowl by means of the hand, but this takes a much longer time.

Another plan is to put the dry clay in an old cloth and let it soak; then pound it with a heavy piece of wood or other instrument from the outside. Needless to say, the cloth does not last very long, and therefore it is well to bear in mind what has been said above—viz. that care bestowed upon the clay when once it is in good condition is well repaid.

If clay is only used in a school during the summer term, it should be allowed to dry, for clay kept damp during the winter months and not taken from the box is apt to have a musty and unpleasant odour.

A wire bow for cutting the clay (see *Brick-making*), modelling knives for the older children, damp sponges, boards on which to model, and cloths, American cloth, or paper to protect the top of desks or tables, should be provided.

For the keeping of models, movable shelves that fit into a framework fixed to the walls will be found useful. The shelves may be placed close together for flat models or wider apart for large ones; in this way economy of space is effected and the models can be kept to dry with ease and safety.

Models that are required to be kept in a damp condition from one lesson to another should first be covered with a damp linen cloth and then covered over with American cloth to exclude the air. A little care is all that is needed to keep these models in the right condition for working.

The advantages of clay are as follows: it is cheap, models when dry may be taken home, and it gives an artistic surface. The disadvantages (some of these really advantages): it requires care to keep it in good condition, it shrinks when drying, models may crack, it is apt to be a messy occupation under a poor teacher.

The advantage of the plasticine is that it is always ready for use. It should be supplied to each child in a tin box, and grease-proof cardboard or some kind of metal tray should be given on which to work; ordinary cardboard or wooden boards absorb a certain amount of grease from the plasticine. If the plasticine should get hard (which is very seldom), place it in a warm place and then work it up; if it is still difficult to work, add a little pure vaseline.

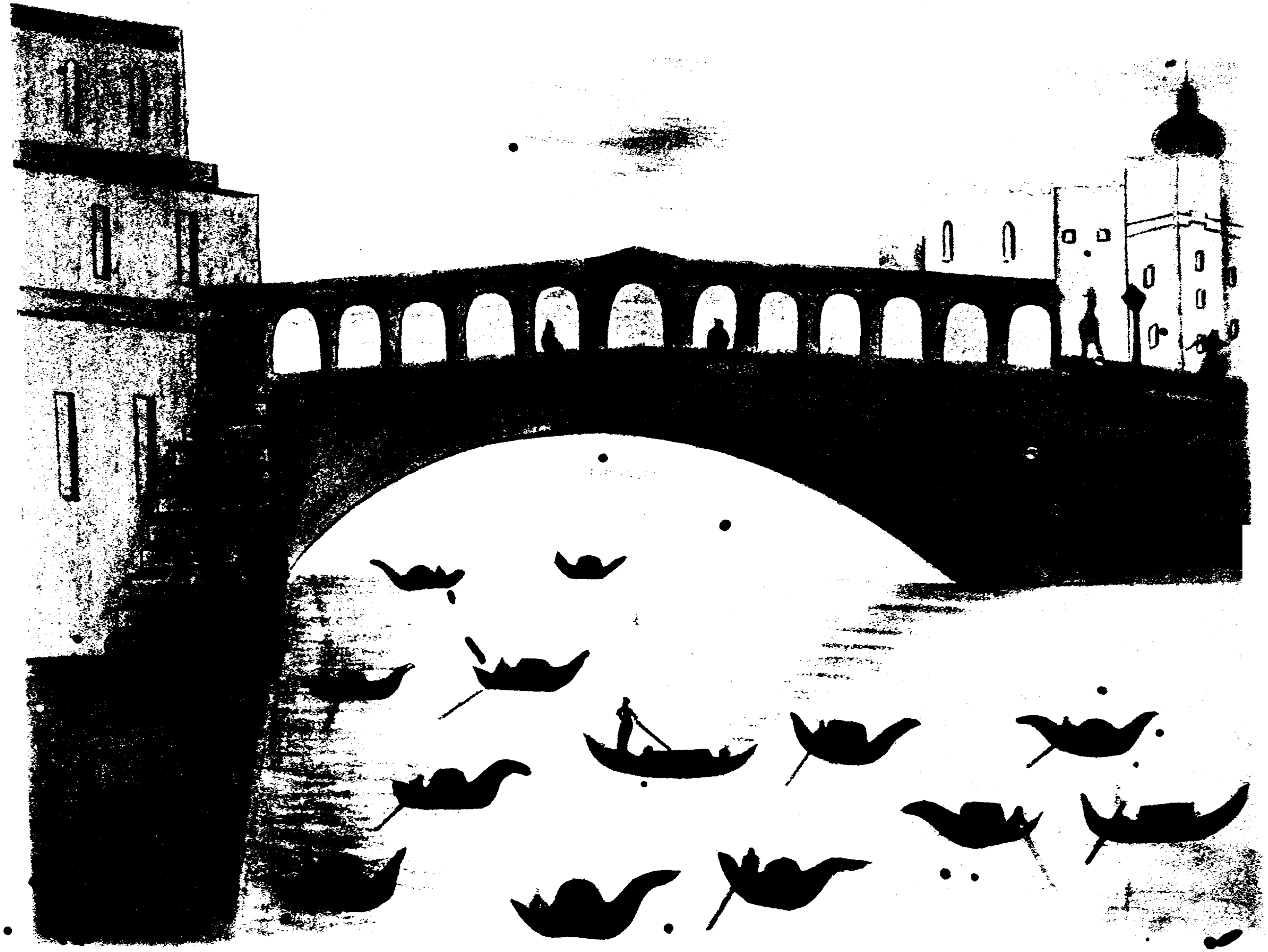
The disadvantages attached to plasticine are that the models never dry, and therefore are apt to be spoiled if handled very much. When finished, they have always a slightly greasy look. The material is expensive, so that children cannot be supplied with large quantities; and this leads to models being made on too small a scale, which is not good for young children.

Other plastic material, such as Modlex, may be obtained at 8*d*. per lb. It can be used in the same way as plasticine.

BOOKS FOR REFERENCE

M. L. H. Unwin: *A Manual of Clay Modelling* (Longmans); J. Liberty Todd: *New Methods in Education* (Orange Judd Co., New York).

PLATE V



PAPER CUTTING: A SCENE IN VENICE
(Background sketched in by the teacher)

XLIV. PAPERWORK FOR BABIES AND BEGINNERS

By Miss L. L. Plaisted

Lecturer at the Bingley Training College; Author of "Handwork in Early Education."

Value of Paper Work.—Paper is a good material for the simple constructive arts practised by young children. It is cheap, abundant, and as children may have it for the asking, they can continue at home what they have started at school. By handling and using paper of varying thickness and texture the children unconsciously gain experience through the sense of touch, and they learn to realise the special fitness of a particular material for a particular purpose. Even the warmest advocate of special sense training will agree that the education gained through the practical use of a variety of material is a valuable means of re-enforcing the lessons gained by more formal methods.

Forms of Paper Work.—There are many forms of paper construction—*e.g.* twisting, crumpling, tearing, folding, and cutting. As the individuality of the child and the need for closer correlation with his home life are emphasised more and more, the elaborately worked out courses of work disappear, and children are encouraged to experiment as freely as possible.

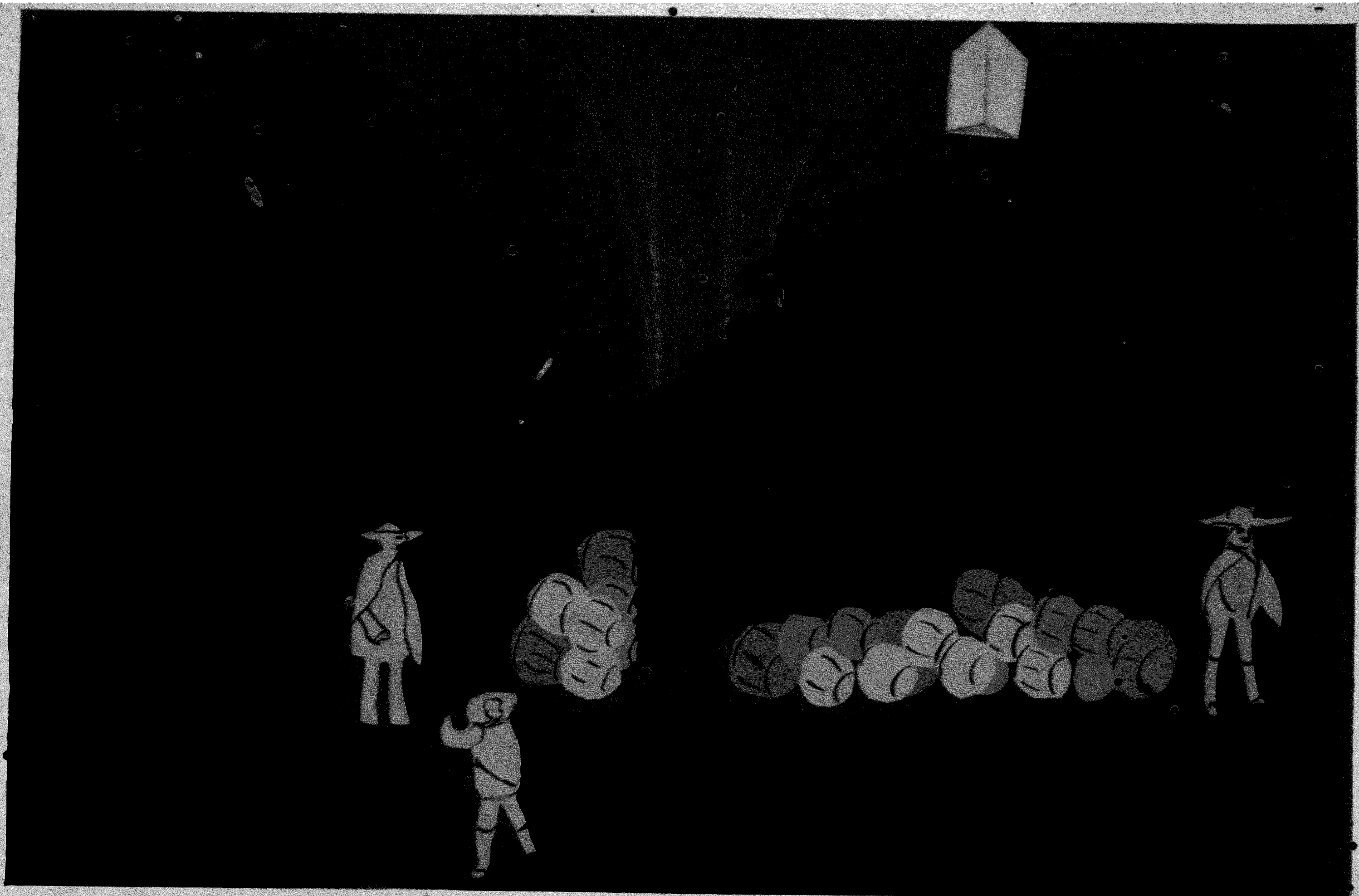
The simple resources of nearly all ordinary homes may be drawn upon for these arts in many ways. The paper bag which we inflated and burst with such delight when we were children may have a more extended function, and a "paper bag play" will prove what ingenuity little ones can show in adapting a bag to their respective ideas. One will draw it on his head as an aid in transforming himself into a baker, another will twist it cunningly into a dwarf's headgear, while a third will pull it over his face, puncture holes for eyes, mouth, and nose, and masquerade as Guy Fawkes or an All-Hallows ghost. Others, with the addition of bits of wire, knitting cotton, or a cork, will manufacture anything that strikes them from a dolly to a corked bottle. Fully inflated, it may serve as a balloon for playing in the wind, or as a harpoon float for Eskimo fishing plays.

A sheet of newspaper is a useful property which may play many parts. It may precede more careful folding and modelling, and the three- or four-year-olds will mould and shape it into the semblance of many common and uncommon objects.

Twisted and coiled with upstanding arched neck and open mouth, it becomes the cobra of an Indian snake-charmer. Rolled diagonally, it forms a mighty trumpet for the herald in the fairy-tale drama; or if torn into strips, rolled and curved, it may serve as horn for the horn-blower in a mediæval town. Animals may be made by means of twisting, and finished off with any odds and ends which the children fancy. Dolls may be manufactured from any material preferred and effectively dressed in pieces of tissue paper, crumpled or crinkled, and shaped by moulding or tearing. (See the "Father Christmas" and "Granny" dolls in Plate IX.)

Correlation of the Different Forms of Paper Work.—In practice it will be found advisable to combine the various forms of paper work as correlative exercises, instead of restricting a set of children for a long period to one or two so-called occupations, as sometimes happened in the days of formalism. Paper tearing need not be discontinued as soon as scissors have been introduced, but should still be practised occasionally, since it offers an excellent training of hand and eye. In some French *Ecoles Maternelles* the children learn to tear with great skill and accuracy, and the motto "Fingers before tools" is followed literally, since the teachers prefer to disperse with scissors until the children are a year or two older.

Each form of handwork should be used to complement another, and thus children may exercise their ingenuity and judgment as to the form of work to be used. Thus a bonnet (see Plate X.) made by folding may be finished by strings torn from a sheet of tissue paper; and the soldier's hat can be decorated with a tassel made from strips of the same material. The piece of tissue paper for making the ball in the illustration (Plate IX.) is prepared by folding, creasing, tearing in strips, and then hung on a piece of



PAPER CUTTING: GUY FAWKES AND HIS FRIENDS PLACING BARRELS OF GUNPOWDER IN THE CELLAR

(Background sketched in by the teacher)

string after the method of making a cowslip ball, and tied rather tightly.

After a little practice in cutting, it seems natural to the children to decorate a folded object, such as a handkerchief case, with a suitable motive cut from paper. Such an object as a child's feeder may be shaped from an oblong piece of paper and decorated by sticking on a row of suitable little designs cut out from paper of a harmonious colour.

The negative forms which result from cutting these little units suggest a crude *method of stencilling*, and the children find great joy in filling in the spaces with bright colour. The material for the simple stencil needs to be impervious to water, hence sometimes a small piece of American cloth may be used, or an ordinary cartridge paper may be prepared by a dressing of shellac or varnish. The positive forms may lead directly to simple *appliqué work*, and when a suitable picture has been made, the most advanced of the six- or seven-year-old pupils might transfer the pattern to a little piece of bright-coloured material such as casement cloth, which by means of a simple decorative stitch may then be appliquéd to a piece of canvas or other suitable material.

Paper Tearing.—*Its Special Value.*—Paper tearing is one of the favourite occupations of little children, and it may be one of the means by which their so-called natural love of destruction is converted into a love of orderly doing and the deliberate making of things. Children who are too young to use scissors may find in this occupation a means of expression, of developing control over the muscle of the hand, and of gaining power over material.

Kinds of Paper.—The paper used should be capable of ready response to the child's will as expressed through his fingers; very thin paper is apt to be too flimsy, since it is more difficult for the child to keep the control necessary to the carrying out of his idea. Newspaper, lining paper, and several kinds of wrapping paper seem to combine the qualities of ready response to touch with the right amount of resistance; tissue paper, though too flimsy (unless doubled and quadrupled) for some purposes, is useful for many branches of the work, and the brightness and variety of the colours are very satisfying to the child, *First Efforts.*—Babies love to tear paper for the mere joy of exercising their power and of causing change. It seems natural to begin by letting the child do what he spontaneously chooses, even if he choose to be merely destructive, and then to lead him on to a more creative and constructive stage. Thus the child may be given a piece of paper and allowed to tear it into small pieces if he wishes.

In one babies' class a pretty effect was produced with the more brightly coloured of the products by arranging them in a mosaic-like pattern which the children called a carpet. Eventually the bits were put into little paper bags, which, by sticking together the ends, became small cushions. In winter the small torn bits of white paper may be lightly mounted to represent a snowstorm.

The next stage might consist in letting the children tear paper into strips. They delight in the sound of the tearing, and if they can crease and tear the easiest way of the paper, it is not very difficult to keep the strips uniform in width. The longer the strip, the better the children like the tearing. Tearing a sheet of newspaper into strips gives a good opportunity for making a long tear. These strips may be used in many ways: as little brushes, the Fun o' the Fair (as in Plate IX.), decorations to festoon the room at Christmas, streamers for a tiny May-pole, etc. The wider strips might form pennons, and the narrower ones plumes for an admiral's hat, tassels for paper-bag cushions, and tails for kites.

The Next Step.—After the above exercises the children might be given papers varying in size and shape and asked to fringe one, two, or four sides; the papers afterwards being used as tiny towels or mats (see Plate IX.). From the oblong fringed along one side we get a variety of objects, among which may be mentioned several varieties of brush (see sweep's brush in Plate IX.). One little four-year-old child made a good palm tree by tearing strips for the drooping branches and rolling the lower part to represent the stem.

These exercises may serve as a preliminary course in technique, and should be alternated by tearing out from single paper any objects preferred. This shaping of objects is as much in keeping with a child's native interests as the tendency to bite a piece of bread into the shapes of various objects and animals.

Paper Moulding.—The newspaper which often monopolises the attention of the grown-up is also full of possibilities from the baby's point of view. He loves to seize, to shake, and to tear it, and he gains much satisfaction from the rattling and ripping noises made, and from the rapid change of form which the material undergoes in response to his efforts.

Occasional newspaper plays will be appreciated by the three- and four-year-old children. Each child may be given a sheet of newspaper and allowed to rustle and later to squeeze and mould it into any shape he pleases. The objects shown in Plate VIII. include a football, a bird's nest, a basket, a dolly, a rabbit, a fish, and a duck, and are such as young children generally make.

Paper Rolling.—The free play with newspaper may be followed by making rolls with square or oblong pieces of paper, and the rolls may be kept in place by the addition of a little paste. This exercise gives a satisfying result with a minimum of effort, and in the hands of the children such a roll may play many parts, *e.g.* a trumpet, a telescope, a roller, a pillar-box, or a pipe for the Pied Piper.

The paper for these rolling exercises should be fairly stiff—such as common brown, or coloured surface paper.

The results of the first exercises may be cylinders begun by rolling in one side of the paper. Strips are much appreciated for making closer rolls, which, if made of coloured or wall paper, serve as rolls of ribbon for shop games. While cylindrical objects are begun by rolling in a side of the paper, trumpets and horns are often more satisfactory if begun at one corner and rolled diagonally.

Paper Twisting.—A good exercise for the hand and fingers of little children may be found in paper twisting. This may be begun with newspaper or tissue paper. A strip of paper—say 10 in. × 6 in.—may be rolled loosely and then twisted into various objects, such as a snake, a dog-collar, a doll's necklet.

Some common objects may be made by combining twisting and rolling. A candle may be made from a roll by twisting a small portion at one end to represent the wick, a Christmas cracker by twisting a small portion at both ends. A bell may be made by inserting a piece of wire or string with a bead at one end and then twisting about half the roll (see Plate VIII.).

Paper Tearing and Cutting.—*Its Value.*—Shaping objects in the mass first with the fingers and later with scissors offers the little learner a good means of thinking through his muscles, of rendering vague impressions more definite, and of furthering mind-growth. By presenting a silhouette of an object the above occupations serve as a link between modelling in the round and its representation in outline. Their introduction necessitates but a minimum cost for equipment or for material, since waste paper may often be used.

SUBJECTS FOR MODELS.—1. *Common Objects.*—The objects chosen for first exercises in representation will naturally be such as strike a little child, *e.g.* the sun, the moon and stars, a snowman, Father Christmas, a scarecrow, moving objects such as a motor-car or a train.

2. *Scenes.*—As skill is gained, interesting scenes recently witnessed, such as a bonfire, a snowstorm, a May-day festival, or a flower show, will be attempted, and among many other suitable subjects may be mentioned trades, such as the baker and the blacksmith, and the illustration of a story.

When small pictures, which can be consulted by individual children, can be obtained, each child may be encouraged to work towards a common end, and the paper-cutting scenes will furnish a stimulating store of images which may help materially in building up backgrounds of life in other times and places, and in enlarging the child's horizon. Thus the research, and the interaction of mind and muscle necessary to fashion trains of animals for a Noah's Ark procession, or to stock a miniature Zoo with animals typical of various regions, offers a fascinating introduction to Animal Geography.

3. *Stories.*—This study may be continued with great zest through the illustration of beast stories and of fables like those of Æsop; Kipling's Just-so and Jungle Book stories are particularly good for this purpose.

4. *Geography.*—When descriptive stories of life in other lands are begun, a delightful panorama of pictures illustrative of each

typical region may be built up, and contrasted and compared with each other. Many interesting points are brought out during this work. Thus in making pictures of the summer and winter life of the Arctic regions, the children note with delight that in winter some Arctic animals, such as the Arctic fox, hare, and ptarmigan, change their colours to harmonise with their surroundings.

When the pupils are ready to construct picture maps, a map showing the distribution of animal life may be made by letting the children stick on to a blank map the animals characteristic of each region. Maps showing products of the vegetable world may be made later, and by comparing the two the children will have a graphic reminder of the dependence of the animal upon the plant life.

5. *History.*—An interesting introduction to Bible history, to pastoral life, and the transition to the more settled conditions of the dwellers in the Nile valley may be given through description, alternated with dramatic play and with cutting, and combining the results of a series of lessons illustrating the life and migration of pastoral peoples such as the shepherd life of Abraham and his journey from Ur of the Chaldees to the Promised Land, the journey of Joseph to Egypt with the Ishmaelite caravan, or that of the patriarch Jacob to join his favourite son in Egypt.

As the figures are cut out from pictures or from blackboard drawings they are mounted on a frieze for the classroom, or ranged in series on a shelf around the room, and many ideas of the life of the people will be gained.

In the story of Abraham's journey the groups of figures are mounted in the order of starting—first the scouting party, consisting of mounted herdsmen who ride on ahead in search of pasture and water; some distance behind follow the vast numbers of slowly moving flocks of sheep and herds of oxen; later, when the women and slaves who remained behind have struck the tents and packed the household goods, come the loaded camels and packhorses, and the women and children mounted on camels and horses.

Any period of history may be illustrated by cutting and mounting silhouettes illustrating the social and military life. The

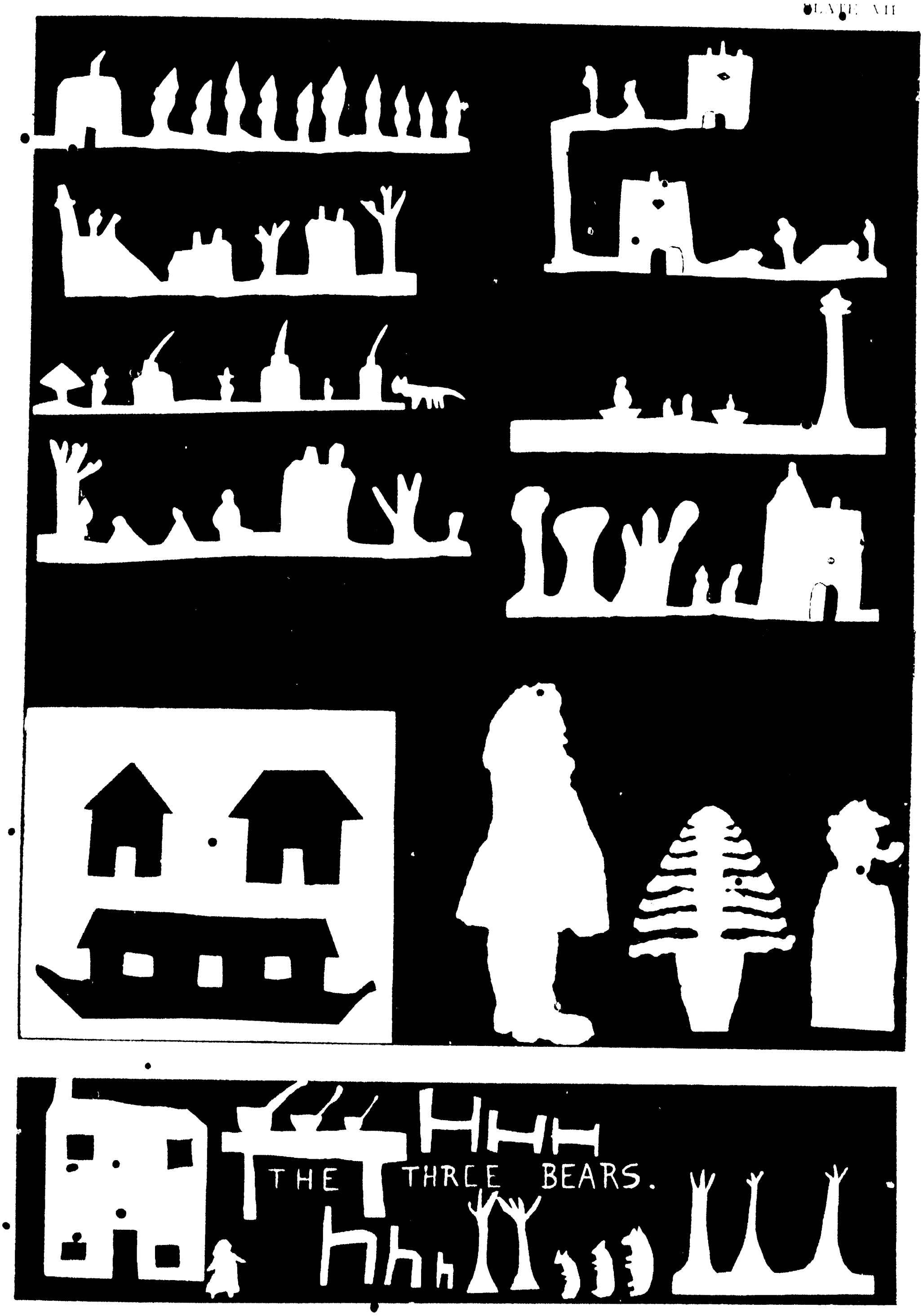
Norman period can be made very vivid by copying the Bayeux Tapestry in paper-cutting. A few copies of the tapestry might be available for consultation, or the children might work from a large illustration. Ideas of the costume, armour, and weapons of each successive period of history may be gained by dressing and arming flat paper dolls in the fashion of the period that is being studied. The figures shown in Plate IX. were hektographed by the teacher, and dressed by the children.

Shields, weapons, standards, and flags may be made large enough for use in dramatisation, and the shields may be decorated with cuttings of appropriate figures—*e.g.* the Arthurian dragon, the Norse raven, the Saxon white horse, etc. Thus the children will be introduced to the beginnings of heraldic device. The development of dwellings, tools, means of transport by land and by water, also lend themselves to illustrating by silhouettes; the different forms of boat, ranging from the dug-out and the coracle to a modern battleship or liner, make an interesting series.

6. *Doll Dressing.*—The dressing of dolls to illustrate an historical period or a geographical region offers one method of approach to cutting out. Starting with soft tissue paper, which, as in the "Father Christmas" and the "Granny" (as shown in Plate IX.), is simply moulded to the doll, the children devise their own methods of cutting out. Sometimes they approach the subject by means of measurements taken from a doll and from each other, sometimes through observation of garments, and more frequently through a combination of the two.

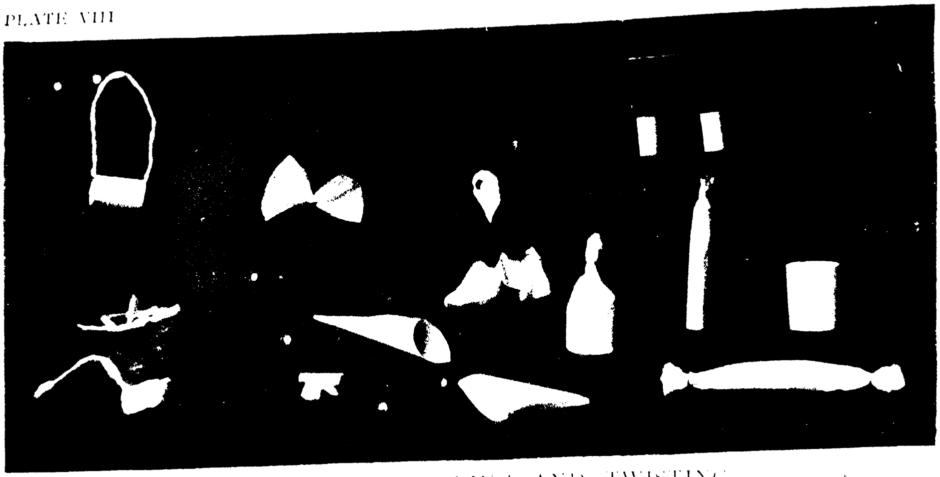
The teacher should have in her own mind a standard of garments in which utility and beauty of line are combined, and she should patiently encourage her pupils to reach this standard by untraditional as well as by recognised methods. Thus in dressing a doll like the Chinese doll in Plate IX., the teacher might make a child's costume of art muslin; and the children in turn would pose in this costume while their fellows observe with some amusement. As they realise the main features of the garment, they try to reproduce a reduced size. Here ideas of scale and of simple arithmetic will come in, as wrong proportions are noted and corrected. There will be an early experimental period, followed by a measuring period.

PLATE VII


THE THREE BEARS.

PAPER CUTTING AND TEARING

PLATE VIII



PAPER ROLLING AND TWISTING

CHILDREN WEARING AND PLAYING WITH ROLLED AND FOLDED OBJECTS

PAPER MOULDING

The material used should be newspaper or the cheap paper used by grocers or confectioners. Sometimes paper serviettes are brought, and these are particularly useful for dressing the Chinese and Japanese and other Oriental dolls.

Paper Cutting.—*When to Begin It.*—As the children show signs of developing some facility in shaping paper with their fingers, they may be allowed to use small pairs of scissors with blunt points, and with such tools much advance may be made. The children generally become so interested in the occupation that a wrong use of the scissors seldom occurs, and since, whether we sanction it or not, most children show a tendency to use scissors, it is advisable that they should be taught how to use them.

Form and Colour.—Paper cutting is mainly an exercise in form, and many people prefer to dispense with colour and to cut in black or white, mounting the cuttings on a contrasting white or black ground. Young children love colour so much that when they cut out in white they invariably insist on colouring the cuttings if they get the opportunity. Hence it is well sometimes to use white paper and coloured pastels or water-colour paints, and sometimes coloured paper. The fireplace in Plate XI. was cut from black paper with a piece of red in the grate to represent the fire.

Sometimes very good effects are obtained by using three tones of paper, *e.g.* grey, black, and white. Snow scenes work out very well in these tones. Thus in making an Arctic scene the sky may be grey, the ground and the igloos white, while the animals and people are cut out from black or dark-coloured paper. Many kinds of paper may be used for paper-cutting, including brown paper, newspaper, wall paper, drawing paper, coloured surface paper glazed and plain. Sometimes children can cut papers to the desired shape and size, but a supply of prepared papers, such as can be obtained from any educational depot, should also be on hand.

First Scissors Exercises.—The first exercises in the mastery of the scissors should be tried on a fairly firm paper, since the child grips the tool tightly in his untrained fingers, and hence needs a paper offering some little resistance. He should be shown how to hold and use the scissors. When they are first given, he may play at making the "biting dragon" open and shut its mouth, and he will love to watch it work its magic in the hands of the teacher, who should cut rows of paper dolls or of Noah's Ark trees.

The first exercises should consist of snipping or cutting in which the whole or part of the blades is used. In the course of these exercises fringes and fringed objects for use in the doll's house may be cut. Ham-frills may be made by cutting a strip of doubled paper and taken home by the proud makers. Strips for making paper chains and little squares for threading alternately with straws or bamboos may be cut during the first exercises.

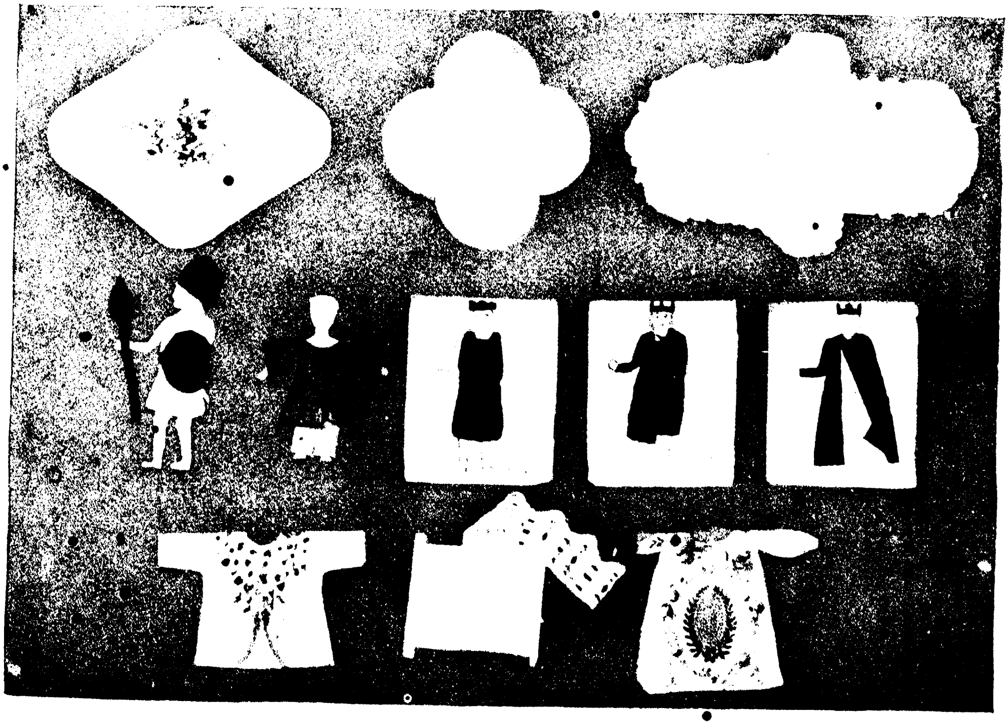
Folding and Cutting.—Probably the desire to obtain results more quickly will suggest doubling the paper intended, for instance, to serve as a doll's towel, and doubling and redoubling the square or oblong that is to serve as a mat. This will prepare for the making of designs and many transformation scenes. Gates, ladders, and railings are quickly made by folding and cutting. These may be given to the children as puzzles. As soon as they discover how to make the object set, they are generally ready to experiment and to invent fresh objects.

Long Cutting.—Longer lines may now be attempted, and if samples of wall paper can be begged, these will probably have patterns which will serve as guiding lines. If not, sheets of newspaper may be cut down the lines of the columns, folded and cut again. Strips of wall paper may be cut, joined together, and used as ribbon for the classroom shop, or they may be cut into lengths of one foot, one span, one finger joint, etc., and may thus introduce the idea of measurement with various units.

Free Cutting or Drawing.—The first exercises in free cutting or drawing with the scissors should be very simple: the child should be shown how to hold the paper in his left hand and to move it to meet the scissors in cutting. This free cutting should be begun on single paper, unless pairs of objects are being cut. Cutting out pictures from newspapers or designs of birds or animals from wall paper may at first alternate with free cutting. These wall-paper cuttings may be mounted on stiffer paper and made into covers for books, blotters, and many useful little articles.

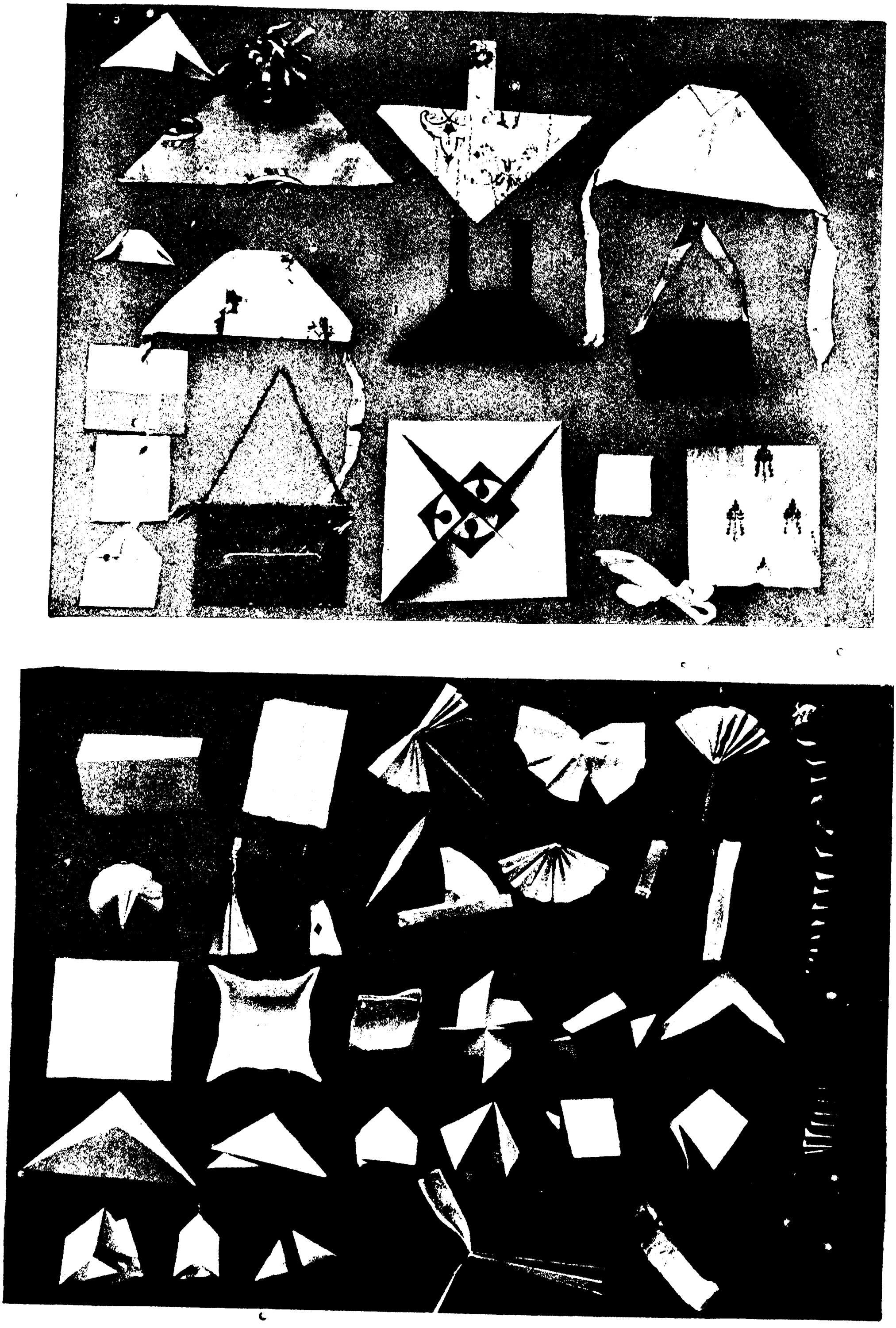
Sometimes in illustrating stories a group of children will

PAPER TEARING AND DOLL DRESSING



PAPER CUTTING

PLATE X



PAPER FOLDING

combine to make a picture; at other times each child makes his own.

After spending some time in cutting out single objects, children often cut spontaneously from a piece. One little six-year-old child arrived at this method entirely without suggestion, and it was found that she had received much stimulus in the direction of cutting from watching her aunt cut out dresses. Other children reached this stage of cutting from a piece through leaving a strip of paper at the bottom of their objects to make them stand.

The stories illustrated in Plate VII. consist of: *Ten Little Red Men, Jack and Jill, The Three Bears, Rose Red and Snow White, Jack and the Beanstalk, Grace Darling,* and *The Elves and the Cobbler.*

Folding in Paper and other Material.—*Not to be Mechanical.*—Formal paper folding as done in some schools and kindergartens was not infrequently regarded by the children who practised it as a mysterious art possible only with paper of the exact shape and size stored in the school cupboard. True educative work, which should not necessarily be restricted to paper, but extended to any other suitable material, will make the folding one of the most popular and also the most useful occupations for young children. It is little wonder that the following of elaborate directions and the making of intricate patterns proved an unsatisfactory exercise both to children and teacher. As we keep in touch with the real needs of child life and realise the children's love of doing and making something useful, such arid and unsatisfying exercises are replaced by work on more natural lines.

Skill as a Means.—Though in a freer and more purposeful use of the occupation the emphasis is less and less on the development of skill and dexterity and more and more on a child-like and natural use of the material, we should not altogether lose sight of the care and accuracy necessary to satisfactory work. Instead, however, of making skill an end in itself, it will become a means to an end, and thus arises a very important difference in attitude. The child with a congenial task which he is anxious to finish well, such as the making of an envelope to contain a letter to his mother, or a pie-frill to ornament a dish for the table, will take great pains and put forth much effort that he may better accomplish the end which he has in view.

The Materials.—These will vary somewhat with the work chosen, and, at least for practical applications and enlarged models, the children should be encouraged to judge which of several available materials will be best for the purpose. For the ordinary kindergarten paper folding the paper should be firm and thick enough to show the creases plainly; but the more elaborate patterns cannot be folded easily if the paper is too thick. Squares, oblongs, equilateral triangles, and circles will be needed.

When a model of any property which the children might use in dramatisation has been made in miniature, they should be allowed to repeat it in a size large enough to be used in dramatic plays. The bonnet, the soldier's hat, and the handbag in Plate X. are some of the objects which have been made in this way, and among suitable materials may be mentioned blue and purple sugar paper, wall paper, and thin cardboard.

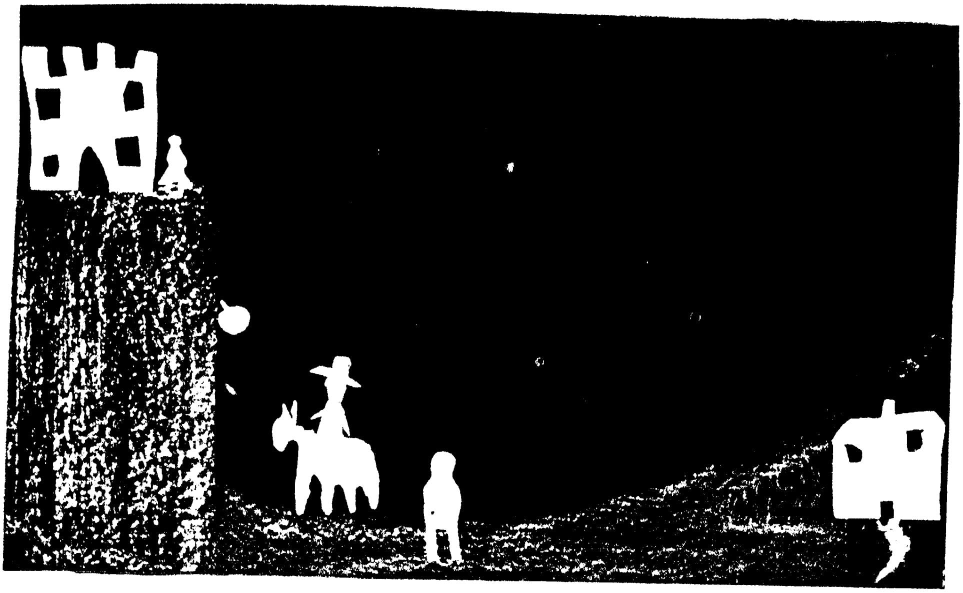
For the practical life exercises, such as the tying-up of parcels, sheets of paper may, if necessary, be bought from a paper-shop at about 5*d.* per quire.

Kindergarten Paper Folding.—This is generally restricted to the making of toys and symbolic representations of objects in the child's world, to the folding of symmetrical forms for conventional designs, and to the conventional paper folding. If we consult the old-fashioned manuals in which this occupation is worked out, we shall find that often in the desire to show completely developed courses the child with his preferences and interests has been forgotten.

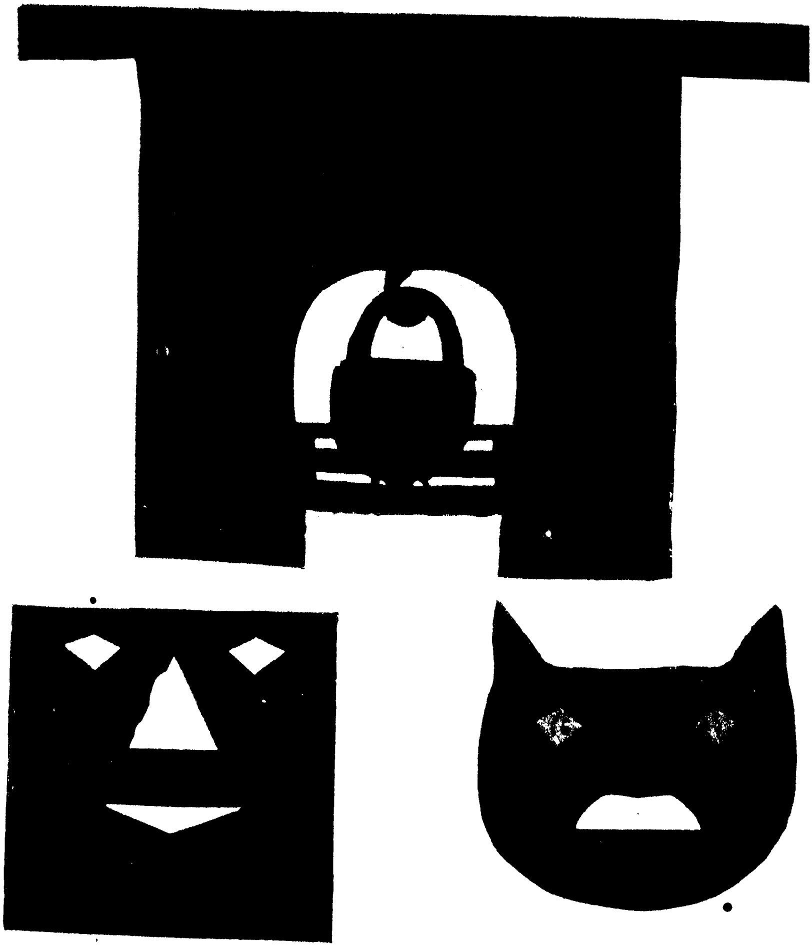
It is true that the child lives in a world of make-believe, but that is no reason why we should limit his occupations to the symbolic stage, since most natural normal children like sometimes to make something useful. They like to imitate what they see their mothers doing; hence some form of practical life exercises, such as the folding of pocket-handkerchiefs, towels, doll's-house properties, and dolls' wardrobes, should be included. This may be a good means of taking advantage of the folding-up fever so graphically alluded to by Mrs. Fisher in *A Montessori Mother.*

The children of seven to nine years of age can cover their

PLATE XI



THE PRINCESS ON THE GLASS HILL



COLOUR EXERCISES (RED PAPER FOR FIRE IN THE GRATES, ETC.)

S.H.

books with paper, pack and tie up little parcels as a part of dramatic shop play, and learn to fold serviettes. Thus the paper-folding plays may serve as introduction to this branch of simple housecraft.

Early Work.—Much of the early work in paper folding should be entirely free, and the children might be allowed to choose the form (square, oblong, equilateral, triangle, or circle) which they prefer. Little by little the possibilities of the material may be suggested, and free individual work may alternate with group work. There will, of course, be many types of lesson and many varieties of method employed in conducting them.

The form the lesson takes at any particular time will be determined by the teacher as she watches the developing child. To-day she leads him to make a choice of the best material for constructing a paper toy, and to this end she lets him select what he prefers from various papers suitable and unsuitable, and then compare his results with those of his neighbours; to-morrow the paper is chosen for him, and through doing, observing, and exchanging ideas, he discovers some of the possibilities of the shape he is using, and suggests names and uses for the objects which result from his work.

Another day a large model is placed before a group of children, or each child is given one for his own observation and allowed to puzzle out the method for himself; the next day a definite ground form is taught, and the children are invited to exploit its possibilities by making anything they can within the limits of this particular plan.

As skill is gained and the powers of invention strengthened, the exercises increase in difficulty, and vary with the child's needs and growth.

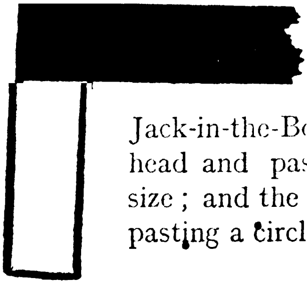
The Use of Ground Forms.—Reference has already been made to the paper-folding courses so fully worked out in books on kindergarten method, and although a literal following is to be deprecated, the student of handwork may often gain from them ideas which may be turned to useful account. I propose to lay but little stress on the development of a number of objects from a ground plan, since by that route much of the slavery to mechanical details creeps in; hence the ground plan should, where possible, be related to a real object, *e.g.* a screen, a shawl, a newspaper, a handkerchief case, etc. Many ground forms should be invented by the children.

In addition to the free work, the children need to be carefully and definitely taught how to fold neatly and exactly. A few minutes of such teaching may occasionally be given through the folding of ground plans. The teacher may demonstrate to a group of children by folding a large sheet of paper, and then let the children imitate. During these short imitation periods the children will learn how to place the paper squarely on the table; how to fold towards and away from themselves, from left to right, and from right to left; and how to make a satisfactory crease by pressing with the back of the thumbnail and not with the fingers.

As soon as the ground plan is made, the children should be allowed to experiment freely, in such simple objects as the book, the screen, the shawl, etc. Free experimentation generally means that the children arrange the folded paper in various ways and suggest any name which occurs to them. Thus the book may be a roof or a trough, the screen a step, a sideboard, a piano, or a flat bow for dolly's hat.

Plate X. shows a number of paper-folding objects developed from the book and the shawl, a cracker and blower, paper toys, Jack-in-the-Box spring, and concertina.

Folding Strips Over and Over Each Other.—Two strips in contrasting colours may be given to the children. The length will vary with the object it is intended to make. For the Jack-in-the-Box spring and the concertina seen to the right of the illustration they measured respectively 2 ft. and 1 ft. in length. The two ends are placed together and at right angles to each other thus. They are then stuck and folded over and over alternately until the whole of the paper is used up. Names are readily suggested by the children. The Jack-in-the-Box should be finished by adding a little head and pasted into a cardboard box of appropriate size; and the concertina looks quite realistic if finished by pasting a circle of black or dark stiff paper on each end.



A Blower (see Plate X.).—This is made from rather soft paper (12 in. × 9 in.), folded over and over so as to leave a channel through which to blow, rolled up tightly and then blown out. This is similar to the "teasers" sometimes sold at fairs and local feasts, but the latter are often furnished with a monkey's head or a piece of metal.

BOOKS FOR REFERENCE

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XLV. HANDWORK AND HISTORY

By J. B. ROBINSON

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Limits and Purpose.—The exercises contained in this article deal with the social side of history only, since of the three great divisions of history—viz. the social, the international, and the political—that dealing with the changing social conditions of the people is the simplest, the most important, and supplies the teacher of young children with an instrument of superior educative value.

Handwork applied to history will help the child to realise conditions. It will bring him into sympathy with, and help him to think in, the spirit of the age, and, where the objects constructed form an evolutionary series, it will strengthen the fabric of his knowledge, just as a few longer strands in the warp and woof produce a material of superior merit.

There is little need to apologise for the fact that no notice is taken of the Roman occupation. It was a high civilisation thrust in upon, and quickly withdrawn from, one of much lower status, and the whole force of circumstances prevented it from exercising a great influence on the evolution of society in our island at that time.

The models given by no means exhaust the paths which might be traversed. They are advanced as illustrative examples. Nor yet do they in every case form an unbroken evolutionary series, for, with one or two exceptions, they are copied from illustrated manuscripts, and indicate recorded fact rather than reasoned theory. The intervening steps procured by research or a study of kindred civilisations might with advantage be added.

It is not intended that any one pupil should work through all the models in any series. That would take too much time,

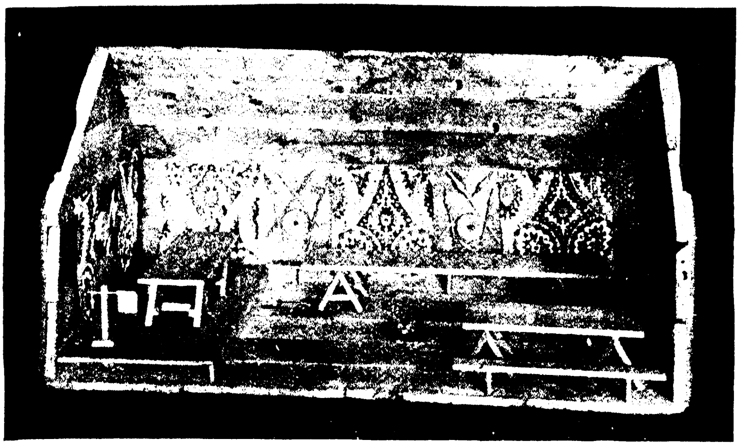


Fig. 3.

SAXON HALL

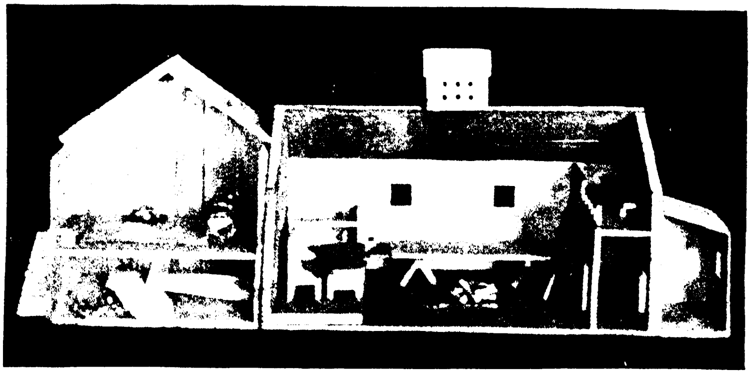


Fig. 5.

MANOR HOUSE

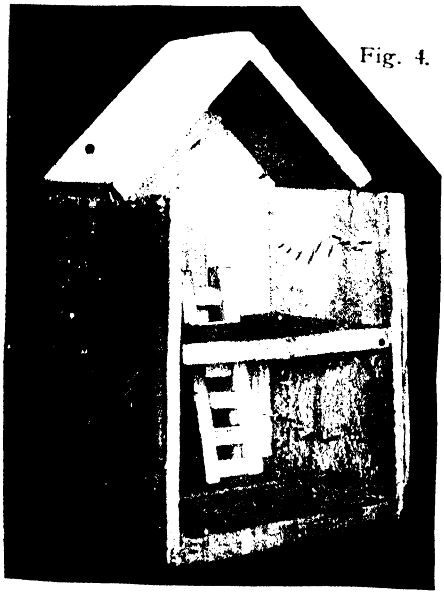


Fig. 4.

PEASANT'S HOUSE

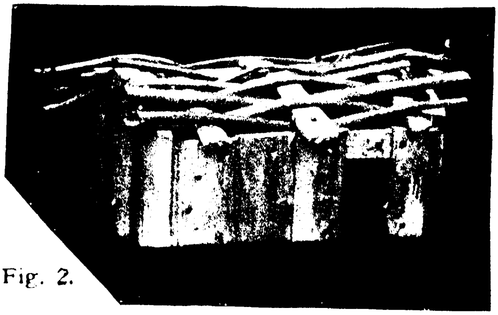
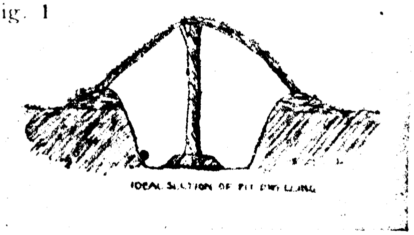


Fig. 2.

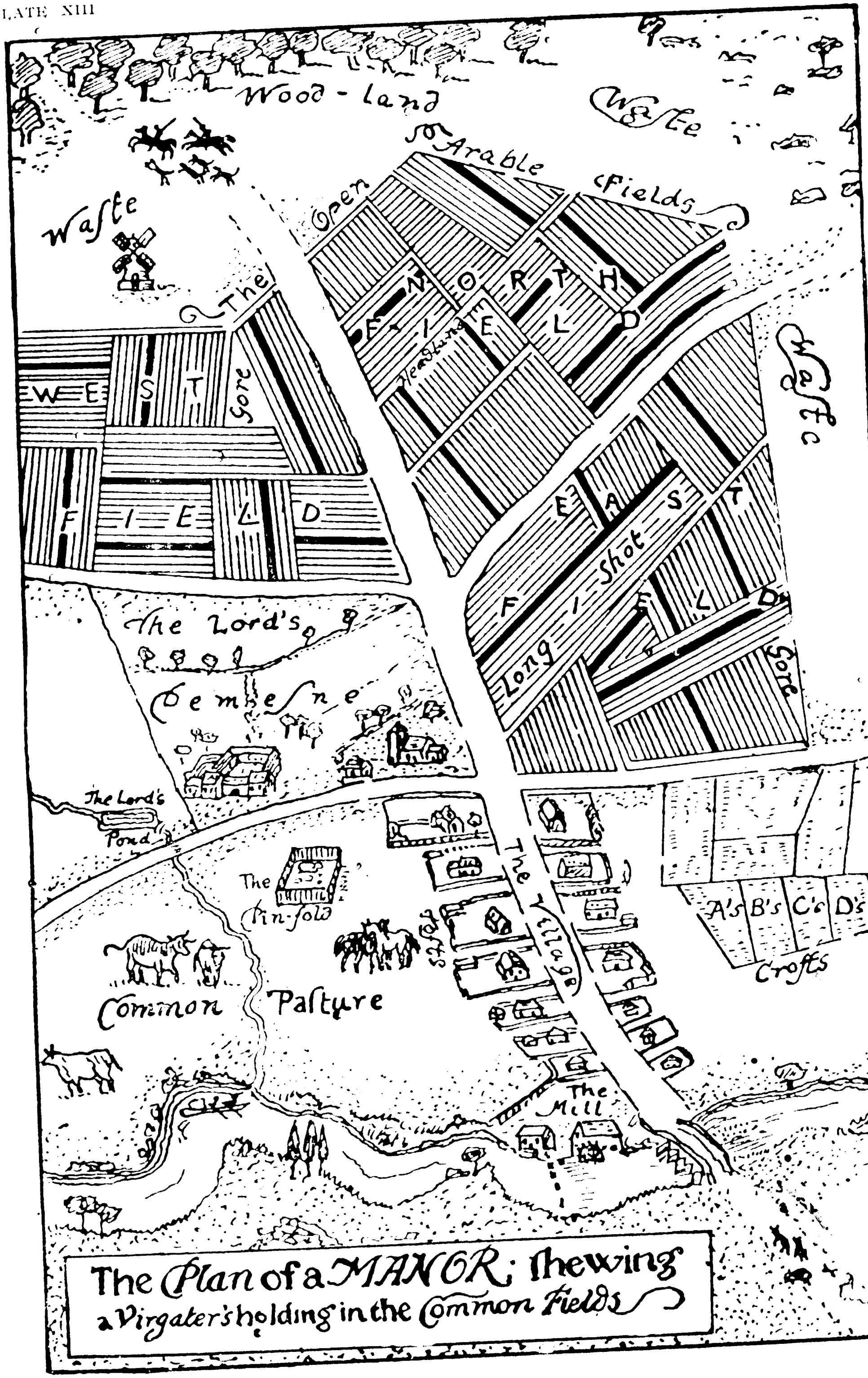
CELTIC HUT

Fig. 1



PIT DWELLING

DWELLINGS



The Plan of a MANOR: ſhewing a Virgater's holding in the Common Fields and produce too much repetition; but, for the sake of breadth, the whole class might produce the whole series, and so an opportunity for "community work" would present itself.

The Evolution of the Dwelling.—Palæolithic man after leaving the trees made his home in the cave, the entrance being guarded by a wicker screen and a fire which burned continually. From this was evolved the rudely constructed pit-dwelling of the Neolithics. The discovery of metal and the fashioning of bronze implements enabled the Celts to fell trees and construct for themselves log huts after the manner of those found in the lake villages. The Anglo-Saxons had but one word for "to build," that was "getimbrian" (to timber). They were workers in wood, and did little more than enlarge, and in a small measure improve, the style of edifice originated by the lake dwellers.

On the other hand, the Normans were stonemasons, and though the manor houses were built of this material, the dwellings of the labouring classes showed little improvement on those erected by their Celtic and Anglo-Saxon predecessors. In fact, till the fall of feudalism all such dwellings were timber erections with wattle and daub roofs, and usually had a single room with a central hearthstone, the smoke finding outlet where it could.

The Cave.—Before modelling a cave, one, no matter how small, should be visited—if this be possible—and its formation and structure discussed. An examination of the rock and its strata, the roof and the floor, will provide excellent material for exercising observation and inference, and a discussion on its suitability as a dwelling will lead to the idea of the desire experienced by primitive man for a superior home.

The model of the cave may be made out of doors, to a fairly large scale. It may be worked co-operatively in clay by a group of pupils, or it may be constructed by one individual working alone. In any case the method to be employed in building up the modelling material is so commonplace as to render special instructions here unnecessary. If the first method is adopted, the stakes for the door screen will be driven into the ground, but in either of the other methods it will be necessary to sharpen the ends of the stakes and force them into pricker holes made in the modelling board. Rigid loppings of trees should be used for stakes, and thin flexible twigs for weavers.

Outside the cave should be represented the fire, the midden, and all the other evidences of primitive humanity, A short, thick-set doll with heavy limbs and long arms should be dressed in fur hung from the left shoulder, and placed near the entrance to the cave to complete the scene.

The Pit Dwelling.—Plate XII., Fig. 1, shows an ideal section of a pit dwelling. To construct a model, make on the modelling board a thick slab of rather hard clay, and dig out in it a circular hole of the required diameter. At some distance from the edge make an oblique tunnel sloping down to the floor of the pit. Such was the entrance. Secure a rigid twig with a fork at one end, and, after sharpening the other end, wedge it securely into a hole in the modelling board. Place a hearthstone near the central pole, cover the floor with rushes, and place lengths of stick at suitable intervals stretching from the clay to the fork of the upright. Weave in and out amongst these some pliable twigs or rushes, and daub over with soft clay. Round the base of the roof so constructed, make a low wall of clay, which in the original was for the purpose of keeping out water.

The pit dweller was an Iberian. He was short and dark, and possibly the dark Welshmen of the Rhondda Valley are his descendants. He dressed himself lightly in wool or skins, and, as in the previous case, a doll complying with the above description should be dressed and placed near the habitation.

The Celtic Dwelling.—Each dwelling was large enough to contain a whole family, ranging from grandfather to grandson, in one room. It was square or round, and was built of unhewn or roughly hewn trees placed on end, with a roof of interlaced boughs covered with rushes or clay. In the middle of the floor the family fire burned, and along one side of the room was a bed of rushes covered with hides or coarse cloth.

The materials employed in constructing the model illustrated in Plate XII., Fig. 2, are ⅜-in. strips of wood and the hoops of a butter barrel. Cut from the strips two pieces of the length required for the side of the hut, and nail to them, as crosspieces, bits of the hoops to represent the roughly hewn logs. After completing this, a third diagonally placed strip will be necessary to produce rigidity. This should be added. In one side an aperture should be left as a door.

The ends of the hut are made in the same way, the slope of the roof being produced by sawing after the railing is completed. The four sections are afterwards nailed together. A piece of strip wood is next inserted between the apices of the gables to support three or more crossbands, into which the roof is woven and finally daubed over with moist clay.

The Anglo-Saxon Labourer's Dwelling.—It was customary for the Anglo-Saxon labourer to sleep with the cows; but when he had a separate home, it was so like the previously described Celtic hut that detailed reference to its style and construction is unnecessary.

The Anglo-Saxon Hall.—The Anglo-Saxon hall was a long low room, very like a cow-byre, built entirely of wood, with its hearth fire in the midst, the smoke escaping through holes in the roof. The floor was covered with rushes, and along the side walls were benches on which the warriors sat. In front of the benches were rough, square-edged trestle tables, which were carried out when the drinking-bout commenced. At one end of the room was a raised platform furnished with a table, seat, and hawk's perch. The walls were hung with coarse woollen fabrics to keep out the draughts, and were also provided with wooden pegs on which the inmates suspended their armour.

The model illustrated in Plate XII., Fig. 3, was made from a suitably proportioned packing-box, and was the work of ten or a dozen pupils acting in co-operation. Two adapted the box, cutting it down to form the slope of the roof and covering it on the outside with barrel hoops to imitate the style of architecture seen in the Anglo-Saxon wooden church at East Grinstead. They afterwards nailed in position the raised platform or dais.

The trestles, benches, table-tops, hearthstone, and wall hangings were produced by other groups. The trestles are of $\frac{3}{8}$ in. square material, the table tops of wood $\frac{1}{4}$ in. thick, and the spears, battle-axes, and swords were whittled from similar material.

Pieces of modern tapestry were hung on the walls, and a bit of slate framed round with wood acted as a substitute for a hearthstone. The door of the hall is in the middle of the front, which in the model is removed to display the contents. The roof was thatched with rushes, which, after being laid in position, were held there by means of string tacked through into the wooden foundation underneath.

After making the model, the pupils displayed great interest in the description of a feast and a carousal. Subsequently they made some of the Anglo-Saxon musical instruments, and listened very attentively to extracts from the poems of Cædmon and the riddles of Cynewulf which were read to them. *Britain Long Ago*, published by Harrap & Co., was found useful in this respect.

The Norman Peasant's Dwelling.—The dwellings of the Norman peasants show a slight improvement on the Anglo-Saxon hut. They varied in size with the wealth of their owners, but all were two-storied wooden buildings built on the same plan. Communication between the two floors was maintained by a ladder passing through a hole in the upper floor. The furniture, consisting of a table, bench, etc., was all home-made, and round the walls hung the agricultural implements (described and illustrated elsewhere) used by the owner in his daily toil. The fire burned on a hearthstone in the middle of the lower floor.

The model, Plate XII., Fig. 4, was made from a small box. The outside was covered with twigs, the lower part of which, reaching to the first floor, should have been daubed with clay. The roof needs thatching.

The Manor House.—The hall was the centre round which the English home developed. In Anglo-Saxon times it was the common living and sleeping room, and the centre of the life of the tun community. The Normans added private apartments to one end of it, to provide secluded accommodation for the lord and lady; and to the other end additions were made in the form of a kitchen and servants' quarters. As these additions grew in number and size, the utility and importance of the hall decreased, and eventually it came to occupy its present position as the entrance only of the abode.

In Plate XII., Fig. 5, is a representation of a manor house. Three boxes were used in making the shell. The largest, in the middle, is the hall; the smallest, on the right, makes a lean-to kitchen;

while the other, on the left, is divided into two stories to do service for the cellar and the solar.

The furniture found in the hall is more elaborate than that used in Anglo-Saxon times. On the dais is a superior fixed or dormant table, behind which is a seat with a back and curved arms. At the far end of the dais is a dresser or "cup-board." In front of the door leading into the kitchen is a wooden partition, pierced by two doors entering a passage, and supporting a gallery. The passage was called "The Screens," and the gallery, reached by a ladder from the hall, was occupied by the minstrels. On the roof is a louvre—the first attempt to deal with the smoke problem.

The solar was entered by means of outside stone stairs, though in some cases these led up from the hall. A window opened from the solar into the hall, and allowed the lord to witness all that transpired in the latter place. Another window furnished with a seat pierced the south wall of the solar, and allowed the sun's rays to enter it—hence its name. In the middle of the back wall of the solar may be seen another step forward in the evolution of the chimney. The use of stone made it possible to remove the hearthstone next to the wall, and above the fire is a canopy, the smoke escaping through a hole in the wall behind it.

The solar was more elaborately furnished than the hall. It contained a bed, chairs, table, and window-seat. The floor was covered with rude carpet and the walls hung with tapestry. The windows were either latticed, or oiled parchment was nailed over them to serve as a substitute for glass.

In making the furniture, ¼-in. wood is used, as in the Anglo-Saxon hall. The arms and back of the seat on the dais are shaped with the knife and the several parts nailed together. The ends of the table are cut to the required size, and the feet are made by first boring with brace and bit, and afterwards removing the part between the holes with a knife. The shelves of the dresser are "housed" and nailed to the sides. The back of the minstrels' gallery rests on a strip of wood nailed to the end wall, and on the front of the gallery is an ornamental railing made of ¼-in. strip wood.

The parts of the louvre are nailed together. Holes are bored in the sides to allow the smoke to pass out, and notches are cut in the ends to fit the slope of the roof. The stairs leading to the solar are made of pieces of wood ½ in. × ¼ in. in section, nailed together, each piece being set back on the piece immediately below it. The canopy covering the solar fire is made of three pieces of wood—the front and two triangular ends, which are nailed together and fastened to the wall. The remainder of the furniture found in the solar is similar to that found in the hall.

Evolution of the Manor.—The following tableaux are intended as co-operative exercises, worked out, to as large a scale as possible, on a suitably sized modelling board, of which a description appears in Vol. III. (p. 208) of this work. Sand, clay, cardboard, wood, or any other materials which will add to the realistic appearance of the production should be pressed into service, while in many cases the homes, sheds, fencing and other properties, required to furnish the models, will have received previous attention, and at this stage only need placing in their correct positions in a suitable environment.

Social Condition of Palæolithic Man.—Cover the surface of the modelling board with clay or damp sand to represent a tract of country with hill, dale, stream, etc Make a number of caves scattered more or less widely over the entire surface. Plant suitable twigs into the clay to stand for the dense forests; and to represent the mammoth, elephant, cave-bear, sabre-toothed felix, etc., use clay representations of these animals.

As this was the hunting stage of man's existence, the roughly made weapons of the chase will supply further material for handwork lessons.

Structural Changes.—After the Palæolithic period a great physical change took place, after which England was no longer part of the continent of Europe, for the valley between this country and the continent was submerged, and the British Isles, the English Channel, and the North Sea were formed.

With the aid of a map of Europe showing the raised portions of the neighbouring sea-bed, allow the children to make a sand model, as accurate as their ability will allow, of the continent as it was, and after adding water, if the modelling tray is a zinc-lined one, press down the sand and allow the water to flow over the parts now occupied by the North Sea, English Channel, etc. If water cannot be added, the model should still be executed and the pressing down performed.

Social Condition of Neolithic Man.—This will be treated as in the case of Palæolithic man. The twigs will be stuck in the clay, showing a rough clearing of a virgin forest on which a number of pit dwellings will be constructed, and around these, using rye grass for the purpose, small plots of ripening wheat should be placed. The animals from a Noah's Ark may be used to represent the horned sheep and short-horned oxen with a few dogs acting as guardians. Short, thick-set, swarthy dolls, slightly dressed in wool or skins—for the former a piece of coarsely woven fabric, and for the latter a bit of old kid glove will do—will serve as substitutes for the inhabitants, round whose necks would hang necklaces of stone, bone, or home-made beads.

Other lessons may be given on polished stone implements, the bow and arrow, primitive spinning and weaving, the dolmen, barrow, and sepulchral urns, and rude agricultural implements, as, for example, the digging stick.

The Celtic Tribes.—The Celtic village was of two kinds, one of which, the lake village, will be considered under the section dealing with fortresses. The dwellings in each case were like those the model of which appears in Plate XII., Fig. 2. Represent a tract of country as in the previous models, and plant twigs to represent a forest, scattered along the borders of which are the homesteads which lie between the hunting ground and the pasture or arable land. Near at hand should be represented a rude mine like a quarry, to indicate the newly discovered preparation of metals in the form of bronze.

The Celt was an Aryan, so a doll to represent a tall, fair, long-haired person should be selected to serve as an inhabitant; and another of larger size might act as a substitute for the chief who embodies the growing conception of law. The inter-tribal warfare, which produced such rulers as Caractacus, Cassivelaunus, and Boadicea, may be associated with the fortresses to be dealt with subsequently.

Flat, flanged, and socketed Celts' pottery with its characteristic decoration, the club, the broadsword, the lance, and the war chariot may supply material for other lessons, and impress the improvement which had taken place in the construction of weapons and implements.

The Anglo-Saxon Tun.—As in the previous exercises, a tract of country will be represented co-operatively on a large modelling board. Place in a group representations—either in wood or cardboard, preferably the former—of a hall, sheds, and wattled huts; and surround this group of buildings with a wooden fence, which should have been prepared previously, or with a wall of stone (using pebbles stuck in clay for the purpose), or with a rampart of earth, using here the clay alone.

The land beyond will be divided into three sections. Near at hand rail off a few small enclosures or grass yards, used for the rearing and baiting of farm stock. Noah's Ark animals will represent these. Farther away lies the arable land, which should be divided into three large open fields, in which the rotation of crops was enforced. The field lying fallow should be left smooth, the one under the plough might be scored with a modelling tool, while in the third, grass should be planted to represent the cereal crops raised. Beyond the cultivated portion was the forest. A few logs might be placed near the border ready to be brought home as fuel, while pigs should be represented as feeding in this rough pasturage.

Fasten a small bell to a tree near the centre of the tun. Such summoned the tun-mote. Outside the tun on some open plain a terraced mound should be made. Such was the meeting-place of the hundred-mote. Near this mound dig a pit and erect gallows formed of two rough forked twigs with a crosspiece to show that the mote both made and administered the law.

The Norman Manor.—The plan of a manor is given in Plate XIII. This may be considerably simplified by reducing the number of divisions and sub-divisions in the three fields, by leaving out some of the villagers' houses, tofts, etc., but no large division should be entirely omitted. The manor house, the church, the mill, and the cottages may be modelled in thin card, while lengths of railing for fencing off the tofts, crofts, pinfold, etc., may be constructed of strip wood and splint.

The lord's demesne was usually surrounded by a wall, which

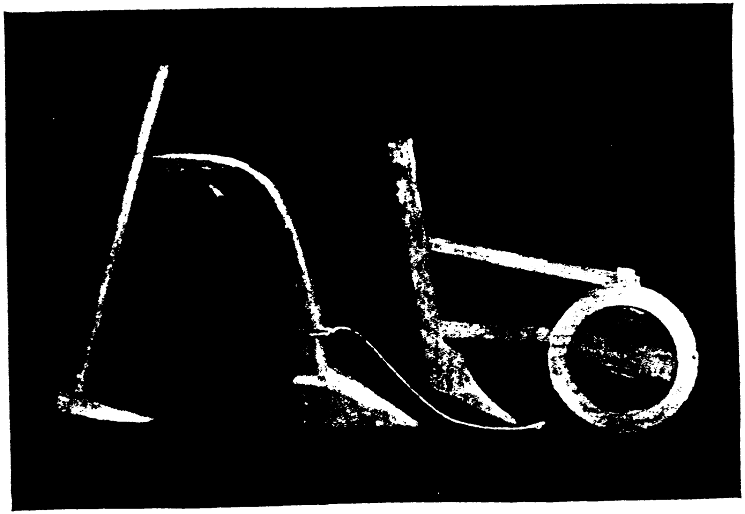


Fig. 2.

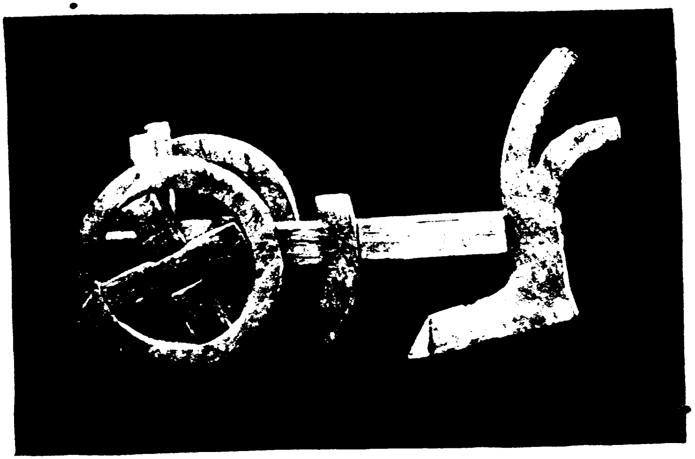


Fig. 3.

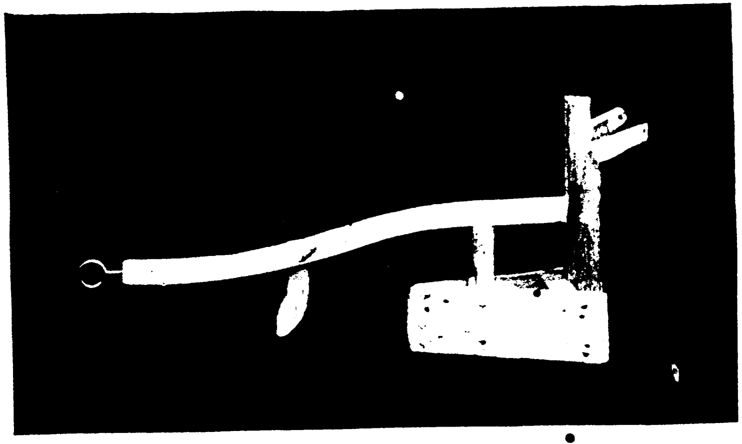


Fig. 4.

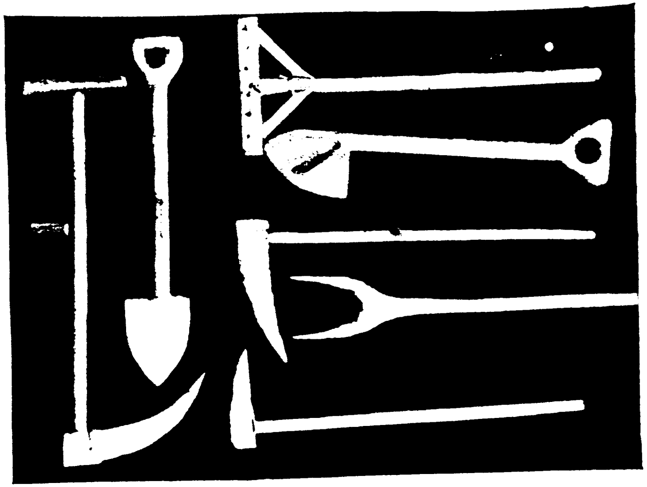


Fig. 1.

AGRICULTURAL IMPLEMENTS

PLATE XV

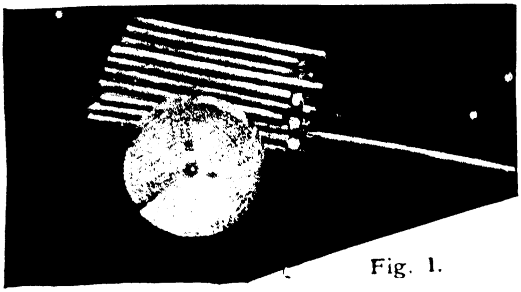


Fig. 1.

BRITISH WAR CHARIOT

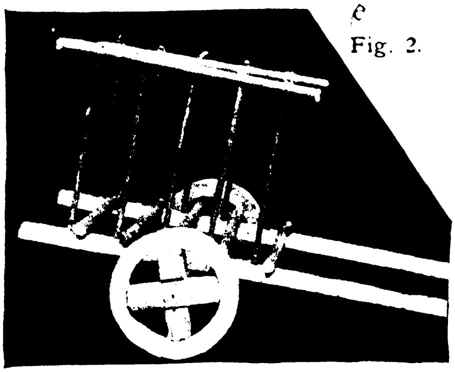


Fig. 2.

ANGLO-SAXON WOODCUTTER'S CART

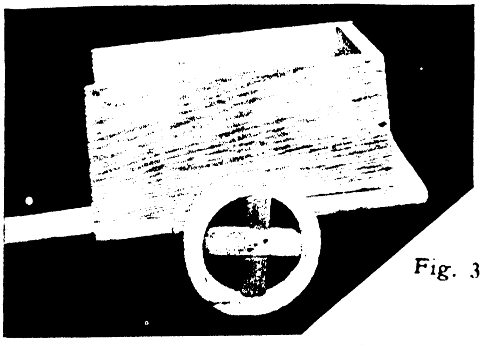


Fig. 3.

ANGLO-SAXON CART

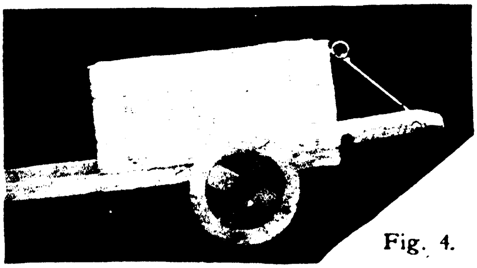


Fig. 4.

ANGLO-SAXON CART

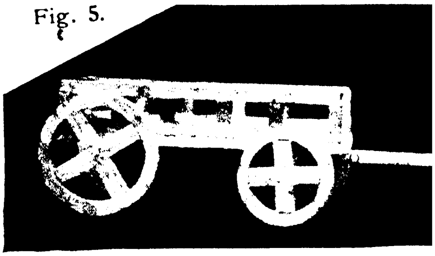


Fig. 5.

NORMAN WAGGON

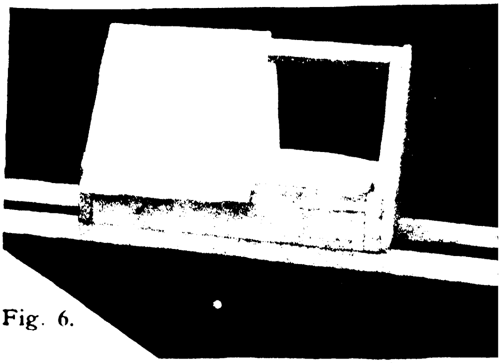


Fig. 6.

HORSE LITTER

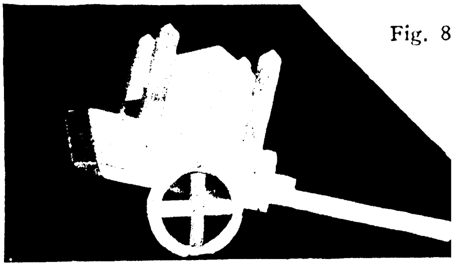


Fig. 8

CABRIOLET

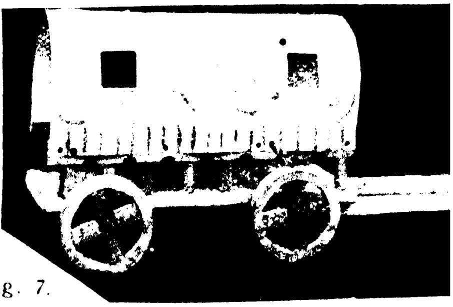


Fig. 7.

ROYAL STAGE WAGGON

LAND TRANSPORT

S.U.

may be made of clay and pebbles. It will be observed that the common arable fields consist, as they did in Anglo-Saxon times, of a suite of three. These should be subdivided into smaller fields called shots or furlongs, which in turn were cut into narrow strips separated from each other by a foot or so of unploughed land called balks. One field should be shown as being fallow, another as carrying a spring crop of barley, oats, beans, or peas, and the third as being sown with wheat or rye. After the suggestions given in the previous exercises, it is hardly necessary to state how these various conditions might now be represented.

Agricultural Implements.—When dealing with the rise of agriculture in England, nothing can be more appropriate than a study of the tools used by early husbandmen, and, as might be expected, the plough offers the greatest scope in this direction. The Ancient Britons scratched up the surface of the soil with a digging stick, which was simply a stout stake sharpened and afterwards charred to harden it. The Anglo-Saxons improved this, and used the one-sided wooden spade illustrated in Plate XIV., Fig. 1, while the Norman implement was balanced (Plate XIV., Fig. 1). The rake and the two-pronged fork (Plate XIV., Fig. 1) are very like those used to-day, but in Saxon times both were made entirely of wood. The Anglo-Saxon scythe (Plate XIV., Fig. 1) had a straight shaft without handles, and the Normans preserved the shaft as it was and added the two handles shown.

All these models can be produced by whittling, but the arch between the prongs of the fork and the holes in the handles of the spades are bored out with brace and bit, while pieces of tin cut to shape are used for the blades of the scythes.

The hoe (Plate XIV., Fig. 2) was the parent of the plough, and was dragged by hand through the loose soil to make a shallow furrow. This was too laborious, and the single-stilt plough drawn by a single yoke of oxen was consequently invented. A glance at Plate XIV., Fig. 2, which is a fairly good interpretation of a one-stilt plough pictured in the Harleian MS., reveals its relation to the hoe. When in action, the pulling force being along the string shown in the illustration, the tendency was for the plough to turn about the nose which became the fulcrum of the lever, and considerable pressure on the stilt would be necessary to prevent this. Evidently the wheel and the cross handles present in the second plough (Plate XIV., Fig. 2) were added to remedy the defects discovered in the earlier form of the implement. A further modification of the stilt, to facilitate steering, and the addition of the coulter will be observed in the plough illustrated in Plate XIV., Fig. 3.

The Norman plough (Plate XIV., Fig. 4) approaches the modern implement, but the curved mould-board which throws over the soil is still absent. All these ploughs were of wood, but the noses of the later examples were armed with metal.

The Hoe.—The shaft and the head of the model of the hoe are whittled separately from ¼-in. wood, and the former is inserted in a hole made in the latter and fixed there with glue.

Plough 1.—The stilt in this case is cut from three-ply wood and the share thickened by applying cheeks to either side. The nails securing the cheeks are well sunk, and the modelling of the share completed with the knife.

Plough 2.—The framework of this model is of ¼-in. square strip wood. The piece forming the stilt and share is whittled from three-ply wood, and the illustration shows the simple construction so clearly that nothing further is needed in explanation. The wheel is dealt with in the next section.

Plough 3.—This example has a central beam into which are "lapped" the axle carrying the wheels, the coulter, the stilts and share. The last two pieces are cut from three-ply wood.

Plough 4.—A curved central beam is present in this case. The share is made of three pieces of wood nailed together and attached to the beam by two upright pieces. The shorter upright is "lapped" to the beam and shaped to fit the space in the front of the share. The longer upright, to which the beam is lapped, is nailed to the crosspiece running between the blades of the share, and the stilts, cut from three-ply wood, are nailed to the rear of the sides of the share.

The Ox-goad.—An essential part of the ploughman's equipment was the ox-goad. It was made of wood with a sharpened end, and to enable him to spur on his oxen when holding the stilts it measured about 16½ ft. in length. It was used to measure the day's work or journey, and is the origin of our rod, pole, or perch. The pupils might be allowed to make one to a scale of, say, 1 in. to 1 ft.

Land Transport.—The simplest vehicle for dragging over the ground was found in the use of a couple of poles between which a horse was yoked, the other ends dragging along the ground. The sledge was a further development, and when rollers were added, the evolution of the wheel commenced. The wheel was in use in prehistoric times in the Old World, and the stages of its invention are unknown, so, as might be expected, early illustrated manuscripts all show the Anglo-Saxon cart with a wheel comprised of hub, spokes and felloes.

While the following models (all, with the exception of the British war chariot, copied from manuscripts) do not show the systematic evolution of the cart, yet they indicate growth and improvement. In the litter may be discerned the sedan chair, though that was of foreign origin; and the cabriolet expresses in rudimentary form the modern "trap." No springs are present in any vehicle, nor are there yet any indications of a swivelled front bogey to facilitate the turning of a four-wheeled waggon.

The British War Chariot.—The British war chariot (Plate XV., Fig. 1) is idealised. It is built up from pieces of willow, but ¼-in. strip wood might be used to make the exercise easier. The base is made first, by nailing lengths of willow to each side of the central shaft until the required width is obtained. The sides and front are gradually built up in the same way, and it should be observed that to increase the rigidity of the body of the vehicle, the lengths of material are arranged at the front corners to form a kind of end bridle joint. A stout piece of willow is nailed to the bottom for the axle, the nails being driven from above, and to it are added two slices cut from a branch to form wheels which rotate on round nails.

Anglo-Saxon Wood-cutter's Cart (Plate XV., Fig. 2).—This cart is copied from an Old English calendar (MS. Jul. A.VI.). The model is made of osiers and ⅜-in. square wood. The shafts are 9 in. long, and in them holes are bored with a thick bradawl, and pieces of osier, with their ends sharpened and dipped in glue, are inserted in the holes. A thick piece of osier is bored in a similar manner for the top rail of each side. In performing the boring, care should be taken to place the breadth of the pricker edge across the grain of the osier, or splitting will certainly ensue.

After the top rails are put in position, the two sides are fastened together by pieces of osier nailed across the shafts. The axle is ⅜ in. square in section, and is screwed to the shaft lengths. The wheels form an advance on those of the war chariot. The rims are cut with a disc-cutter from ¼-in. material and are ¼ in. wide. The spokes consist of two pieces half lapped and nailed together, and are trimmed at the four ends with the knife to fit the inside of the rim. They are fixed in position with panel pins driven through the rim from the outside.

Anglo-Saxon Carts.—Two other Anglo-Saxon carts are illustrated in Plate XV., Figs. 3 and 4. One is open at the front, closed at the back, and has a single shaft; while the other is closed at the front, has an adjustable back-board and double shafts. They are both constructed of ¼-in. wood. After the parts of the bodies have been cut to size they are fixed together by simple nailed butt joints. The axles and shafts, all of ⅜-in. square wood, are next added, and the wheels are built up from rims and half-lapped spokes as previously described. The back of the model (Plate XV., Fig. 4) is hinged by driving two screw eyes into the back lower end of the sides, and driving through these two round nails into the adjustable back.

Norman Waggon.—The Norman waggon (Plate XV., Fig. 5) is made of ¼-in. wood. The outside sizes of the body are 6 × 2½ × 1¼ in. deep. The base is solid, but the sides are built up in ladder-like fashion of ¼-in. square wood and nailed to the base from below. The rear axle is ⅜ in. square and the front one 1 × ⅜ in. in section. This allows the centres of the smaller front wheels to be so placed that the waggon remains horizontal. The diameter of the hind wheels is 2½ in. and that of the front wheels 2 in.

King John's Horse Litter.—The horse litter (Plate XV., Fig. 6) consists of a solid back like a house gable 3½ × 2½ × ¼ in., two sides 5 × 1 × ¼ in., a front 2½ × 1 × ¼ in., and two pieces ⅜ in. square in section halved together at the apex and halved to the front of the litter. The various parts are nailed together, and finally a top pole is nailed in position to carry the cover. A piece of fabric is tacked to the sides to form a kind of hammock in which the occupant reclines. The cover is in two sections, half of which is shown in the illustration to expose the construction.

Thirteenth-century Royal Stage Waggon.—The waggon (Plate XV., Fig. 7) has a solid base 7 × 2½ × ¼ in. The sides are built up from a long top piece and eight small pieces each ⅝ × ¼ × ¼ in. The ornamental top piece is made by boring a series of holes with a brace and bit down the centre of a strip of wood, and afterwards cutting it down the middle. The parts of the sides are then nailed together and afterwards nailed to the base from below. The axles, the wheels, and the shafts are made and attached in the way described previously. The canopy is of thin card, which in the flat measures 7 × 7 in. The windows are cut, the gaudy decoration added with brush and colour, and it is finally nailed to the sides.

The Cabriolet.—The cabriolet (Plate XV., Fig. 8) consists of a built-up nailed cart 5 × 3½ × 1½ in. The elaborate seat is composed of four corner pillars 4 × ½ × ½ in. pointed at the top with a knife. Between these pillars, and nailed to them, are two sides with pointed tops. A horizontal seat, with a vertical back dividing it in two, is nailed between the two sides. After the seat is fully completed, it is placed in the cart and secured in position by nails passing through the sides of the cart and entering the four corner pillars. The shafts are nailed to the inside of the sides of the cart, and to them is added a narrow footboard.

Ships.—The earliest type of ship or boat was the monoxylon or boat constructed of one piece of wood, and usually known as the "dug-out." In such vessels the tribes which invaded our island before the coming of the Romans must have crossed the North Sea or English Channel. To strengthen the dug-out and to increase its carrying capacity, ribs and keel were subsequently added. The vessel unearthed at Brigg, in Lincolnshire, in 1886 and now preserved in the Hull Museum, was of this type.

The next step was to use the ribs alone and cover them with skins sewn together, and in such manner the coracle was produced.

With the advent of metal, man was able to cut wood into planks and fasten these to the ribs with nails in place of the sewn hides, and so shipbuilding proper was inaugurated.

Loose oars, one on either side of the ship, were at first used for steering, but the Vikings discovered that one was sufficient for the purpose. This steering board, to which a tiller was added, was attached to the right side of the ship, which consequently became known as the starboard side. The Viking ships with their splendid proportions and good rudder influenced most European shipbuilders, and remain to-day as models well worthy of imitation.

The thirteenth-century ship was larger and possessed a fore-castle, a fighting top, and a stern-castle, these being introduced by Crusaders.

The Dug-out.—The model illustrated in Plate XVI., Fig. 1, is made from a piece of branch from which a slice had been sawn to form a rough deck. The hollowing out, a rather difficult process, is done with a gouge. The seat, or seats, is afterwards cut to suitable length and breadth from ¼-in. wood and nailed in position.

The Coracle.—The skeleton of the coracle (Plate XVI., Fig. 2) is made of splint taken from an old fruit basket and cut into strips about ½ in. wide. Five of these strips are about 8 in. long and seven about 6½ in. long. These are interlaced to form a base, and fixed at the four corners with wire staples, such as are used by a printer in fastening together the leaves of a pamphlet. The projecting ends of the strips are then made damp and turned up all round to form the sides of the coracle. A long piece of splint is next fastened, by means of staples, to the outside of the turned-up ends, and carried right round the top, having been previously damped at the corners to facilitate turning. Another length is similarly fixed to the inside. A third length is next prepared separately. Its loose ends are fixed in such a position that it just slides over the outer long length previously fixed.

Before adding this piece the skeleton coracle is covered with oiled calico, care being taken to get the corners as accurate as possible. The third hoop is then slipped on, and, using a strong needle and fine string or thick thread, is sewn through and over

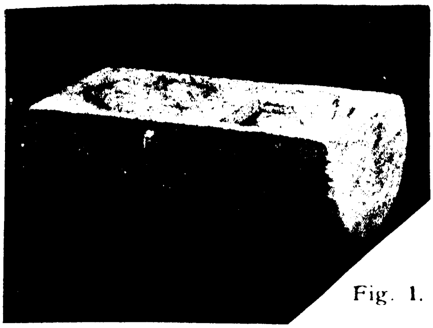


Fig. 1.

"DUG-OUT"

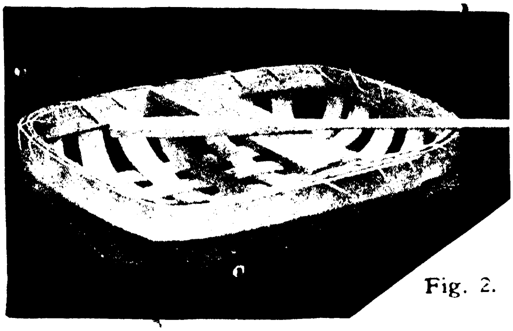


Fig. 2.

CORACLE

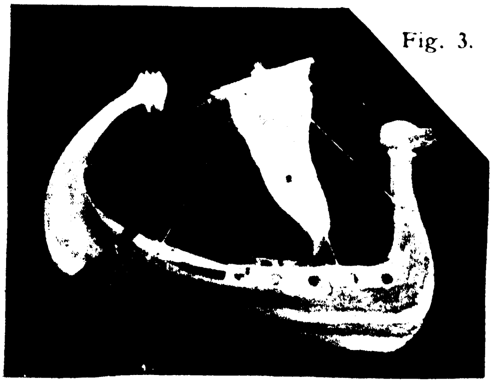


Fig. 3.

ANGLO-SAXON SHIP

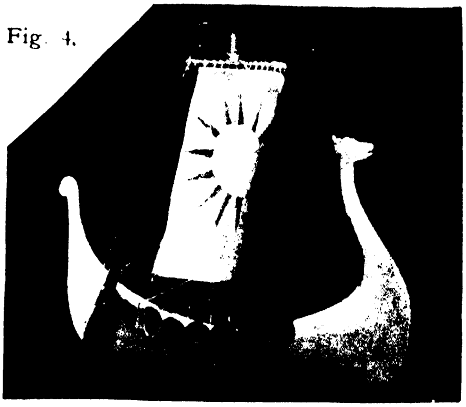


Fig. 4.

VIKING SHIP

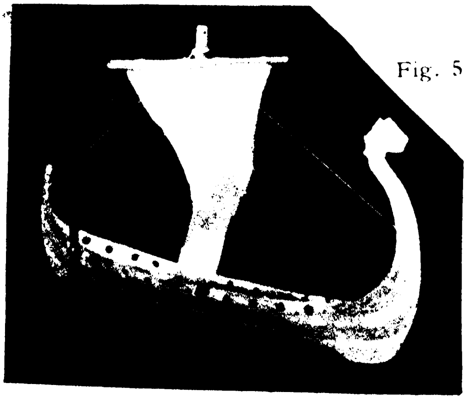


Fig. 5.

NORMAN SHIP

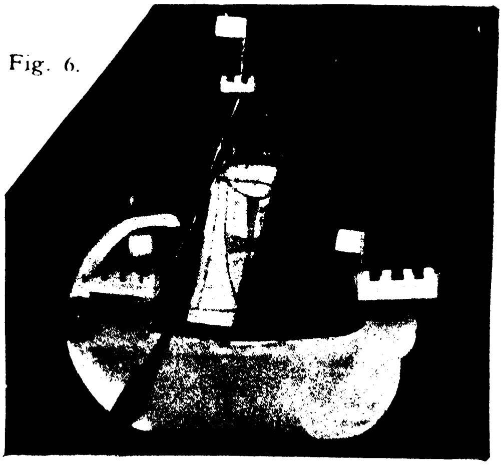


Fig. 6.

THIRTEENTH-CENTURY SHIP

SHIPS

PLATE XVII

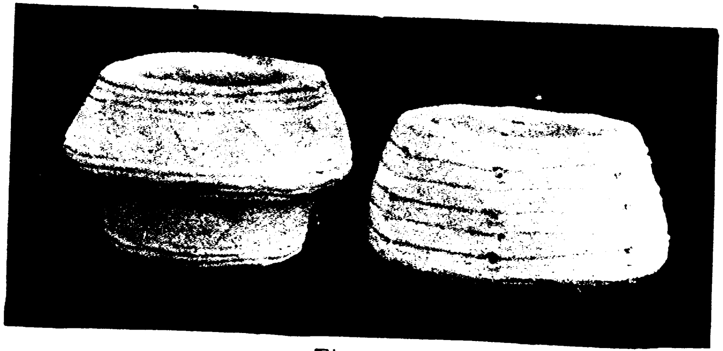


Fig. 1.

FOOD VESSEL INCENSE CUP

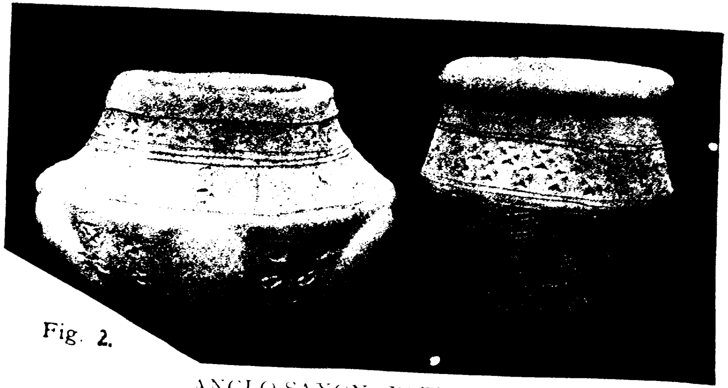


Fig. 2.

ANGLO-SAXON POTTERY

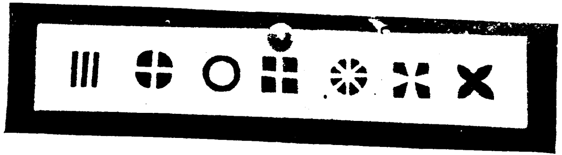


Fig. 3.

PUNCHES

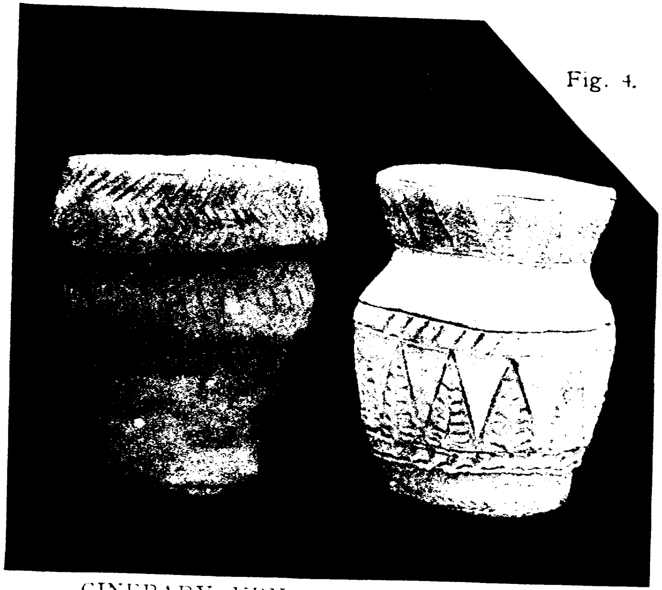


Fig. 4.

CINERARY URN DRINKING CUP

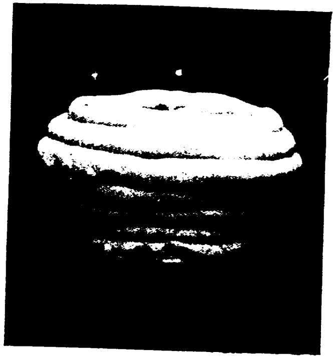


Fig. 5.

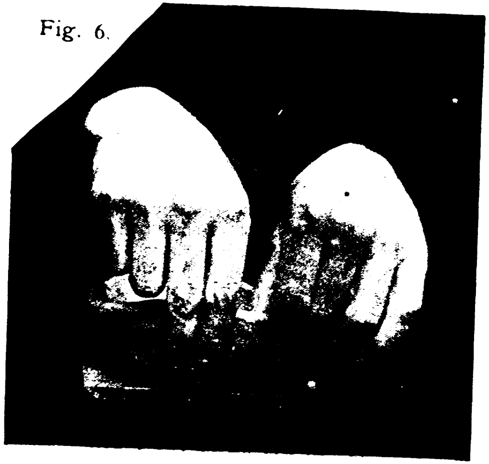


Fig. 6.

POTTERY

S.H.

right round the top edge of the coracle. The seat is nailed in position, and the oar or paddle is whittled from $\frac{1}{4}$-in. wood.

The Viking Ship.—The influence of the Viking ships (Plate XVI., Fig. 4) on those of the Anglo-Saxons and the Normans is readily seen. They were double-ended, so that in battle they could manoeuvre ahead or astern, and in order that they might be easily beached.

The model is made in very much the same way as the North American Indians make their birch-bark canoes. A piece of thin card is folded down the middle and the shape of the ship cut out. The double piece is then opened and glued at stem and stern, and placed under a weight till the glue is set. A suitable lozenge-shaped piece of thicker card is cut to form the deck, and, after a hole has been made in it to receive the mast, adhesive is applied to its edge and it is slipped into position in the hull, where it is held till the adhesive sets.

The mast and spar are whittled, and the square sail, after being decorated, is looped to the latter. The steer-board and shields are added to the hull, and the mast and sail placed in position and secured by the necessary rigging.

The Anglo-Saxon Ship and the Norman Ship (Plate XVI., Figs. 3 and 5) are made in much the same way. Both have triangular sails.

Thirteenth-century Ship.—The construction of the hull of the model of the thirteenth-century ship (Plate XVI., Fig. 6) is similar to that of the Viking ship previously described. The fore-castle is developed from a square, and mounted on two flanges left for the purpose in cutting out the ship. The stern-castle is developed from an equilateral triangle. It is secured in position by means of two flanges, one on either side of the serpent on the stern, and by two pointed match sticks which are inserted at one end in holes in the deck, and at the other end in holes in the floor of the stern-castle. The fighting top is developed from a square.

In the earlier ships the sails could only be lowered by taking out the mast, but in this case we find an improvement, as it could be raised or lowered by a rope.

Into the spar drive a screw-eye which encircles the mast, and pass the string for raising or lowering the sail through a hole in the mast. The rigging consists of one cord to stem, one to each side behind the mast, and one at each lower corner of the sail. The sail is of calico suitably decorated with black-lead pencil.

Pottery.—The earliest forms of pottery were made by pressing clay into a mould such as an open basket, and as the clay dried it shrank and left the mould, and an independent vessel was procured. Afterwards no mould was used, and the method employed in constructing coiled baskets was imitated, the sides of the vessel being built up by using a coil of clay. This comparatively simple method was forsaken at a later date and another requiring greater skill practised in its stead. A piece of clay was taken, and, by a process of stretching and compressing, shape was given to it; but the manipulation employed in doing this suggested the invention of the potter's wheel, which is used to-day in producing the finest examples of the potter's art.

Earthenware vessels are found in British barrows, and have been classified as cinerary urns (Plate XVII., Fig. 4), incense cups (Plate XVII., Fig. 1), food vessels (Plate XVII., Fig. 1), and drinking cups (Plate XVII., Fig. 4). They let in a flood of light on the superstitious beliefs held by the Britons and Anglo-Saxons. For a description of these beliefs reference should be made to the chapter on Animism in Tylor's *Primitive Culture*, Vol. I. All the examples so found were hand-made, and mostly built up in coils and baked in an open fire. They were not glazed, but had been polished by being rubbed over, when partially dried, with a smooth stone or implement of bone. The ornamentation consists principally of straight lines in an almost inconceivable variety. The patterns have been made by a sharp-pointed instrument on the soft clay (Plate XVII., Fig. 4), by impressions ofthe finger nails, and often by the impression of twisted string (Plate XVII., Fig. 1).

Specimens of Anglo-Saxon pottery have been found in their barrows. These were also made by hand, but the clay in this case was stretched and compressed to the required form. Decoration was applied in the form of straight lines, but the characteristic features of the Anglo-Saxon decoration lies in the addition of prominent protuberances (Plate XVII., Fig. 2), and simple geometrical figures produced by wooden punches pressed into the surface of the soft clay (Plate XVII., Fig. 3).

The Normans used the wheel and decorated their wares with ornaments made separately and applied with "slip." They also employed glaze.

British Pottery.—Make on the modelling board a slab of clay about ½ in. in thickness, and mark out on it a circle of the size of the base of the vessel to be constructed. Take a piece of clay, and by rolling it between the fingers and the surface of the modelling board, produce a roll about ½ in. in diameter and place it on and within the circular base already made, pressing the roll down gently and firmly. Another roll should be made, and if the vessel under construction widens, the second roll should be rather longer than the first, and made to protrude beyond it. On the other hand, if the vessel is to decrease in diameter, the second roll will be shorter and will lie slightly within the first roll. In either case the latter addition should be firmly planted on that which lies below it, but the pressure applied must not be excessive, or the shape will be destroyed. Successive additions are applied in this way till the whole is completed (Plate XVII., Fig. 5).

When joining the ends of a roll it is advisable to flatten them slightly and make one end overlap the other. The series of junctions should not lie in a line up the wall of the vessel, but should be scattered over its whole surface. As the coils are added, the spaces between them, both in the interior and on the exterior, should be filled in with soft clay, taking care that, in the process, the sides are not stretched and the shape destroyed by rough handling. After finishing and decorating in the manner previously described, the model should be placed on one side till it becomes leather dry, when it may be polished in the manner followed by the Britons.

Anglo-Saxon Pottery.—It is difficult to describe the method followed by the Anglo-Saxons in producing their earthenware vessels, and those wishing to become proficient in the art must experiment. Procure a ball of clay and press the thumbs well into the middle of it. With the thumbs still inside and the fingers outside, stretch the clay upwards and outwards, keeping the hands moving round and round the pot in doing so (Plate XVII., Fig. 6). The process is similar to that followed by the potter at his wheel, but in this case the hands rotate round the sides of the pot, which remains at rest. Care must be taken to keep the sides of uniform thickness throughout, the fingers in their journey being instrumental in readily detecting differences.

To make the vessel narrower, place the fingers inside and the thumbs outside it. Bend the clay slightly in the direction in which it has to go, at the same time pressing the fingers and thumb of one hand towards the fingers and thumb of the other hand, and so thicken the wall of clay. Allow the hands to travel round and round, repeating the movement on the journey, till the desired shape is secured. Some practice will be necessary.

The protuberances on the Anglo-Saxon vase in Plate XVII., Fig. 2, are modelled in the hand separately and stuck in position afterwards. The punches, specimens of which are illustrated in Plate XVII., Fig. 3, are made of pieces of wood, circular, square, or rectangular in section, the ends being cut with a knife to secure the ornament.

Norman Pottery.—The Normans, as previously stated, used the wheel. Their vessels were simple in form, and clumsy in workmanship as compared with the products of a skilled potter of to-day. It would be too wide a digression from the object of this article to describe how a wheel might be made and used.

The Shop.—The following objects are not in themselves evolutionary, but indicate, perhaps somewhat indirectly, the evolution in the method of effecting an interchange of commodities.

In primitive times each family was self-supporting. The men did the hunting and provided the food, while the women did the cooking and weaving. In the early Anglo-Saxon period each separate community, living in the townships, was adverse to mutual intercourse, and endeavoured to retain its self-supporting economic unity ; but differences in soil, mineral wealth, and other advantages caused one community to interchange with another, commodities which each had in super-abundance. Salt, for example, was required for preserving purposes, and its natural distribution was not universal.

Markets originated and were held on the " mark " or boundary between the estates of different communities, and the market-place was indicated by a boundary stone from which originated the market cross. But markets, held perhaps weekly, met the

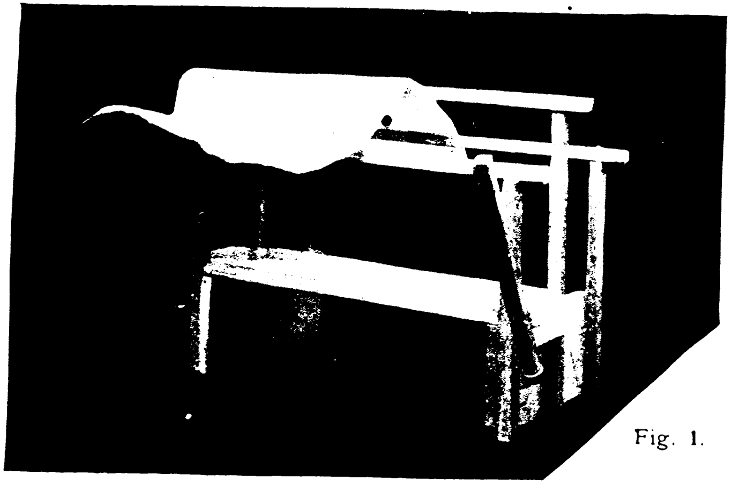


Fig. 1.

THE STALL

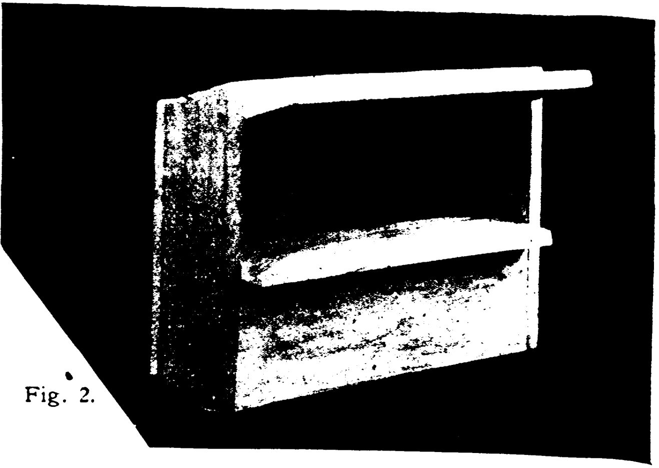


Fig. 2.

THE BOOTH

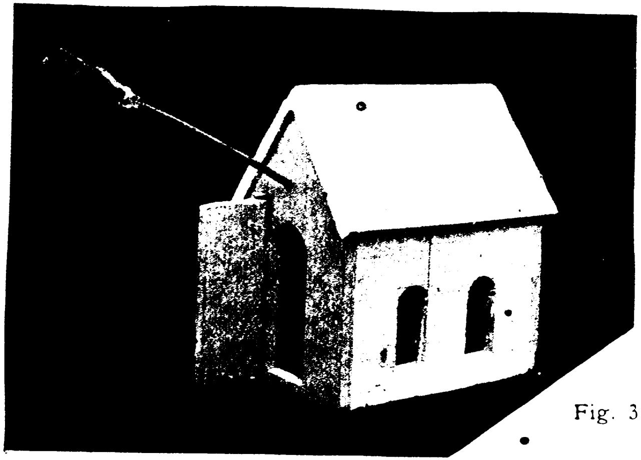
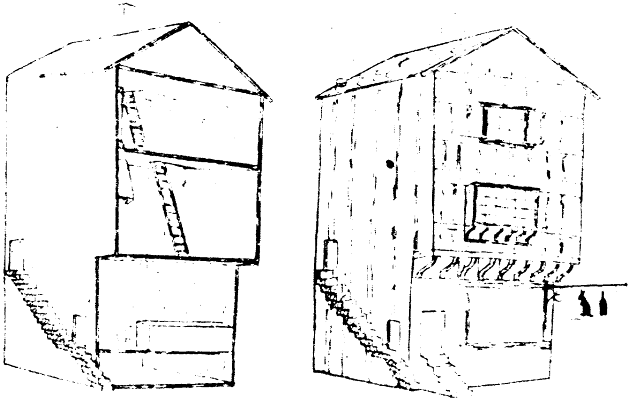


Fig. 3.

Fig. 4.



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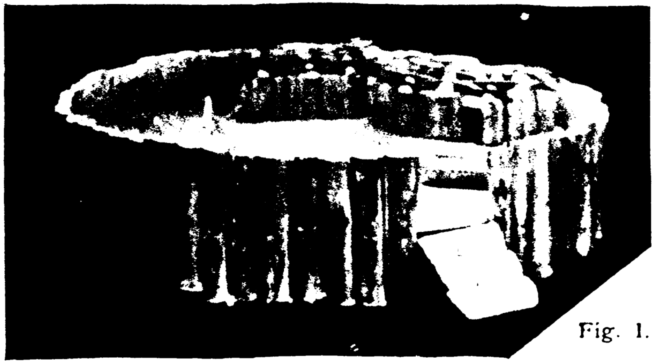


Fig. 1.

LAKE VILLAGE

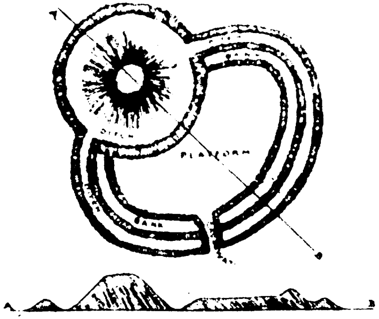


Fig. 2.

ANGLO-SAXON BURH

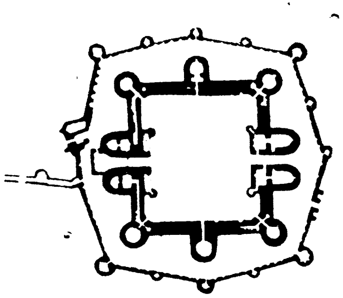


Fig. 4.

PLAN OF BEAUMARIS CASTLE

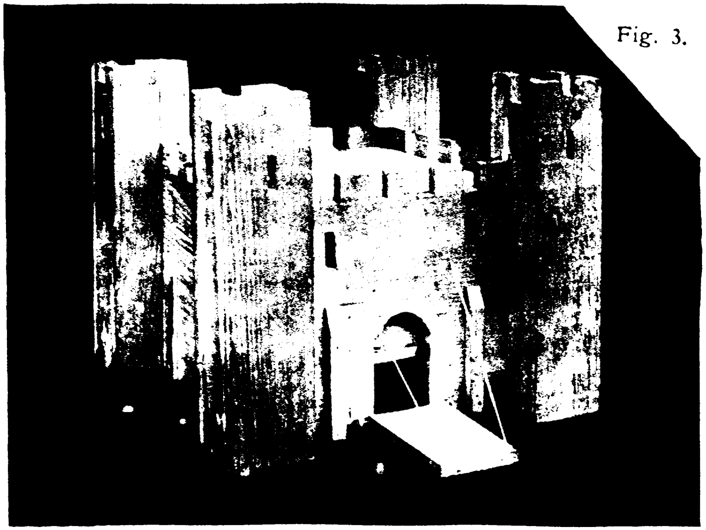


Fig. 3.

NORMAN SQUARE KEEP

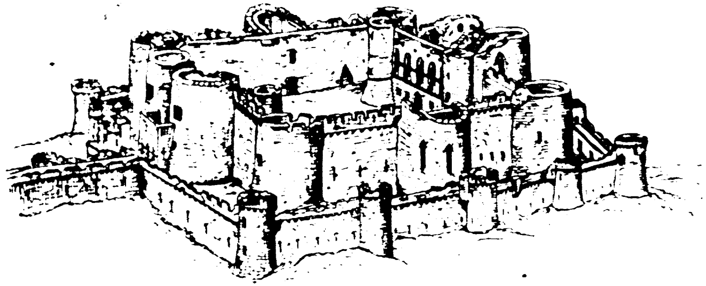


Fig. 5.

BEAUMARIS CASTLE

THE FORTRESS

needs of the locality only, and as a desire for a wider range of commodities increased, the annual fair, attracting dealers from both home and abroad, came into existence. Fairs were necessary for several reasons. The agricultural population was scattered, and the trader could not find sufficient customers even in the towns, which were small. As manufactures increased and towns grew, the permanent shop became part of our trading machinery.

No model of the boundary stone, which preceded the market cross, is given, as no illustration of it has been procured, but in a district where a market cross exists, and they are common, the teaching might centre round the construction of a model of it. The fair is represented by the models of the stall and booth, and the growth of the town by the tavern and shop.

The Stall.—The solid ends of the stall (Plate XVIII., Fig. 1) are 3½ × 1¾ × ¼ in. To these are nailed three uprights, two measuring 4 × ¼ × ¼ in., and one 5 × ¼ × ¼ in. Into the tops of these uprights fine panel pins are partly driven, the projecting heads of which fit into holes in the three crosspieces carrying the cover of the stall. The board, on which the goods were exposed for sale, is notched at the corners to allow it to rest between the upright poles, and has a short crosspiece nailed to each end underneath, to lock it to the ends of the stall. Two screw-eyes, one in each of the front posts, carry the rods, which, capable of adjustment, support the covering protecting the wares. The stall was covered with a woollen fabric, half of which is shown in the illustration, the other half remaining uncovered to expose the construction. The model may be taken apart and put together at will.

The Booth.—The model (Plate XVIII., Fig. 2) is constructed of ¼-in. wood. The outside sizes are: length 6½ in., height 5 in., and depth from front to back 2¼ in. The two sides which slope towards the back, the top and lower part of the front, are cut to size and nailed together. The back has a doorway 3 × 1¼ in. The door is 3¼ × 1¾ in., and is hinged with screw eyes and round nails. Drive a screw eye into the back slightly above the top, and another slightly below the bottom of the door, and, after rounding the back edge of the door, drive a nail through each of these screw eyes into the top or bottom edge of the door.

The closing front of the booth consists of two parts, one wider than the other. The larger part is at the top, and, being hung near its top edge with a single nail at each end, is capable of being raised to afford protection to the goods, and lowered to meet the bottom part when the booth is closed. The bottom part is hinged in the same way as the top section, and when thrown down extends the shelf on which the goods were displayed.

The Tavern.—The early permanent shop was conducted in a cellar and was known as a tavern. It was entered by steps which led from the street, but these became so numerous and encroached so much on the pathway that they were abolished by law.

The construction of the model (Plate XVIII., Fig. 3) is so apparent as to need little description. The tops of the door and windows are cut with the brace and bit. The door is hinged with screw eyes and round nails, as previously described when dealing with the booth. The sign is the bush, which is of Roman origin.

The Shop.—The model of the thirteenth-century shop shown in Plate XVIII., Fig. 4, is made from a suitably proportioned packing-box procured from a tradesman. Its narrow front represents the gable end which faced the street. The box is suitably cut to form the roof, and the front made to represent the overhanging top-stories. The positions of the floors are first carefully marked out, and, after strips have been nailed to the sides of the box to bear the floors, these are placed in position.

The shop floor was raised above the level of the street, the basement being the cellar. Above the shop was the hall, in which the shopkeeper, his family and apprentices lived. On the second floor was the dormitory, a long undivided sleeping-room, and the space in the roof was used as a store.

A door leading into the hall should be cut as shown in the figure. Stairs led up to it from the street. These are made by nailing pieces of ½ × ¼ in. strip wood to each other, each successive piece being set back on the piece below. The dormitory and garret are reached by step-ladders passing through the floors. The shop front is next put in position. It has a door reached by steps from the street and an open window. Across the window is a flat board, behind which the tradesman sat and sold his wares.

The hall was furnished with trestle tables, forms, and one or two box chairs. At the back of the hall was the fire burning on a hearthstone. Above the fire was a canopy shaped like a square pyramid, which pierced the floor above, entered the sleeping apartment, and eventually narrowed into a chimney. The sleeping-room contained a number of flat low wooden beds.

After the furniture is added and the chimney fixed, the front of the upper stories is dealt with. It is not permanently fixed, but can be taken away to show the interior arrangements. The timbering is cut from veneer and glued in position.

A projecting sign-post is added, from which a sign swings. Reading was formerly a scarce acquirement, consequently to write the owner's name would have been of little use, so a rebus was adopted. A hare and a bottle are cut out of coloured paper and stuck on our sign to signify that the owner's name is Harebottle.

The Craftsman's Dwelling.—In considering the growth of towns, due to the rise of manufactures, the craftsman's dwelling deserves some attention. It was so like the Anglo-Saxon hut that special instructions on constructing a model are not necessary. It was of daub and wattle, and contained one room in which the craftsman lived, worked, and slept. In the centre of the room the fire burned. These dwellings were arranged in narrow streets into which all kinds of refuse were thrown. The Black Death found a congenial soil there.

The Fortress.—The British hill fort depended for its efficiency on its elevation and rude rampart of earth, stones, or logs of wood; while the Celts, in improvising their island home, trusted that isolation would render them proof against the attacks of their tribal enemies. In the lake village the movable causeway, reaching from the island to the mainland, expresses the same idea which, in later times, found embodiment in the drawbridge which spanned the moat.

Danish influence is strongly marked in the Anglo-Saxon burh. The ditch, rampart, and stockade were copied directly from the invaders, while the platform, used for storing supplies and keeping horses and cattle, was a modification, suited to the open plain, of the enclosure used for the same purpose by the Danes. The platform and mound of the burh represent in rudimentary form the court and bailey of the Norman keep; in fact, immediately after the Conquest the Normans seized the burhs, and, by substituting a stone wall for the wooden palisade, produced the shell keep. The square keep introduced by the Conqueror was soon surrounded by outer walls of defence; and improved castles, of which that erected at Beaumaris was a type, resulted from the Crusades.

The British Hill Fort.—Model in clay or damp sand a representation of a hill with a fairly flat top. Round the brow, and following the contour of the hill, throw up a rough rampart of sand or clay; or using pebbles build a rude wall; or using suitable branches place them longitudinally one on top of the other. Inside this rampart and on the hill top, represent a number of pit-dwellings. The toy animals from a Noah's Ark will serve for the sheep and cattle which were driven in during times of stress.

The Celtic Lake Village.—The round end of a butter tub or cheese box serves as the base of the lake village (Plate XIX., Fig. 1), and the old hoops of the former, cut into 3-in. lengths and nailed to the edge of the base, form the palisade. A space should be left for the gangway stretching to the shore. The gangway is movable, and is made by nailing lengths of hoop across a strip of wood. On the platform place a number of huts constructed in the manner described in the section dealing with dwellings, and these, with the addition of some toy cows and sheep, will complete the model.

The Danish Stronghold.—Model in clay a portion of coast showing a protected bay flanked by a promontory. Across the neck of the promontory dig out a ditch, throwing up the clay to form a rampart behind the ditch, and surmount this by a strongly made fence of wood. Butter-barrel hoops form good material for this purpose. A causeway, protected by a gate and a movable bridge spanning the ditch, provide the means of access to the open country. Within the enclosure place representations of the horses, cattle, and supplies which have been raided from the surrounding country, and in the protected bay place models of the ships described in another section.

The Anglo-Saxon Burh.—A plan and section of the burh is given in Plate XIX., Fig. 2. Make a rather thick slab of clay and dig out a ditch enclosing a space of the required size and shape. Within this make the mound, shaped like a truncated cone, and raise the platform to the required level, surrounding both platform and mound with a rampart crowned with a fence. The causeway should be constructed after the manner of that used by the Danes. On the platform place cardboard models of a hall, huts, and sheds.

The Norman Shell Keep.—The Normans introduced stone-built fortresses. The shell keep was a ring of wall surrounding an open space, and, as previously stated, the Normans in building one often substituted a stone wall in place of the wooden palisade of the Saxon burh. Inside the wall they erected buildings of wood. The construction of a model will follow the same lines adopted in making the model of the burh, with the wooden stockade removed and the stone wall imitated by one of clay.

The Square Keep.—The model (Plate XIX., Fig. 3) is made of ¼-in. wood, the square corner towers receiving first attention. After the pieces of wood are cut to size, the windows, battlements, etc., are completed and the separate pieces nailed together. Two of the pieces used in each tower are previously slotted to receive the corners of the square body of the keep.

Three of the sides of the body are identical, but to the fourth are added a doorway, a portcullis, and a drawbridge. To make the doorway, use a centre-bit or disc-cutter to produce the semicircular top, and cut up to it with the saw. On each side of the doorway, low down and on the outside, is a small screw eye through which a round-headed nail passes into the drawbridge forming a hinge. The edge of the rectangular piece of wood forming the bridge is rounded with the knife to permit of easy rotation. The portcullis slides in two rebates or grooves, one on each side of the doorway. They are formed of two pieces of wood nailed together, one piece being set back on the other.

On the inside of the sides of the body nail strips of wood on which to rest the floors of the stories. The ground floor was a store, and above were the apartments for the garrison and the owner. When the four sides of the body are completed, nail them together, putting in the floors and the roof. A piece is removed from the front edges of the floor and roof to allow the portcullis to be raised or lowered. Finally, the four towers are added.

Clay should be built up to form the characteristic site of such a building. In the clay a deep hole should be formed to represent the well, and hollows to represent the dungeons; and after the wooden model has been placed in position the moat should be excavated. Glass or tissue paper may be placed in the moat to imitate water.

Beaumaris Castle.—A plan and pictorial view of Beaumaris Castle are shown in Plate XIX., Figs. 4 and 5. It is given as an example of the concentric castle with outer walls of defence. A model might be made co-operatively in clay, and its superiority over the square keep discussed.

Engines of Attack.—In the Middle Ages the art of defence had outgrown the art of attack, and the primitive siege engines could make little impression on the solid masonry walls of the keep. Undermining, underpinning, and firing were the only sure methods of reducing a fortress; but when the foundations of these buildings were laid on a rock, these methods became impossible, and starvation was resorted to. The concentric castle provided ample space for the storage of provisions, while its well in the basement supplied the garrison with water, so the sieges of the twelfth and thirteenth centuries were long-drawn-out affairs.

The engines, originally made of wood, were covered with wet hides as a preventive against fire, and pieces of old kid gloves might be used in the models as a substitute for these. They have been omitted in the illustrations to allow as much of the construction as possible to remain visible.

The Screen.—The screen provided protection for the archer who shot his arrows through the loop-hole in its face. Its construction was simple. The model (Plate XX., Fig. 1) is made of pieces of ¼-in. wood nailed together. The wheels were cut with a disc-cutter.

The "Cat."—The "Cat" (Plate XX., Fig. 2) was used in mining operations. It had no floor, but was open direct to the ground. The model is of ¼-in. wood. The two sides and two ends are

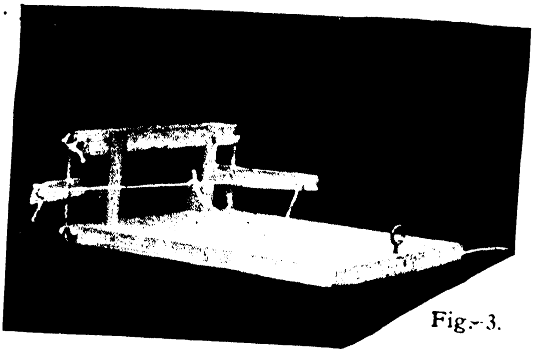


Fig. 3.

THE BALISTA

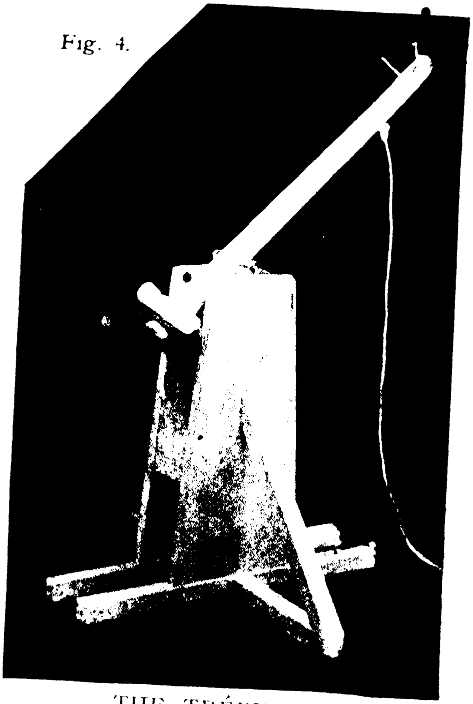


Fig. 4.

THE TRÉBUCHET

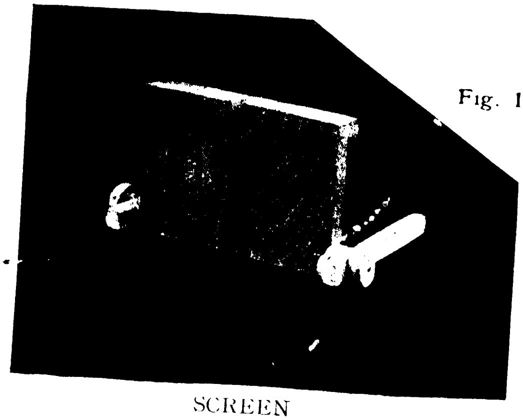


Fig. 1.

SCREEN

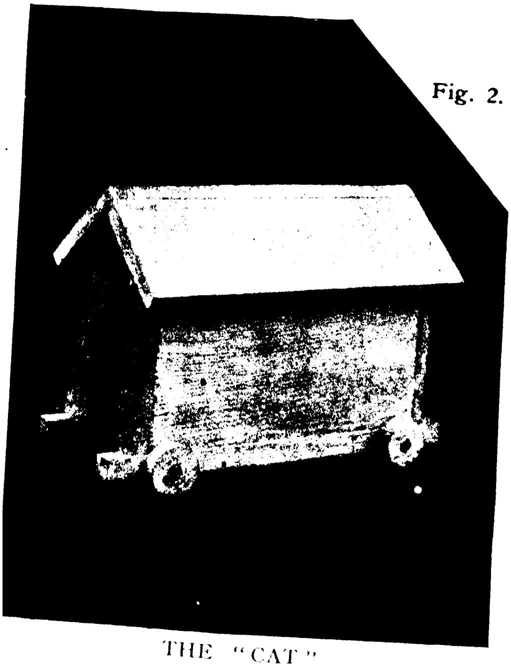


Fig. 2.

THE "CAT"

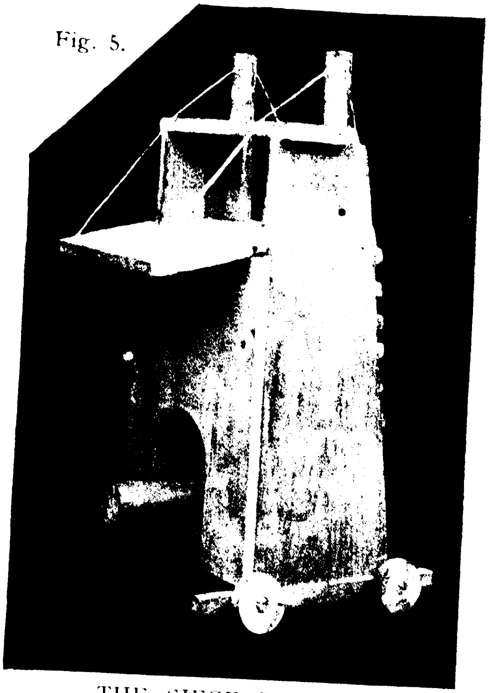


Fig. 5.

THE SIEGE TOWER

ENGINES OF ATTACK

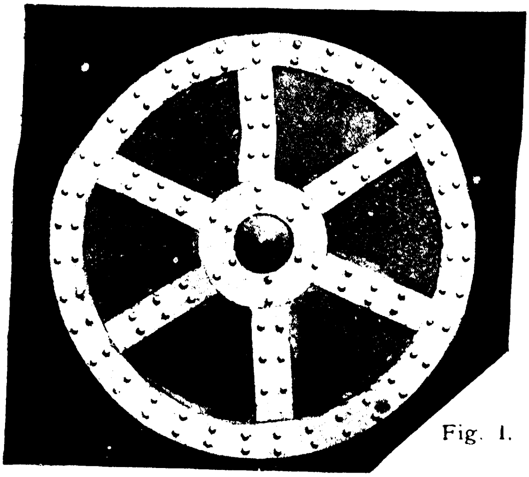


Fig. 1.

ANGLO-SAXON SHIELD

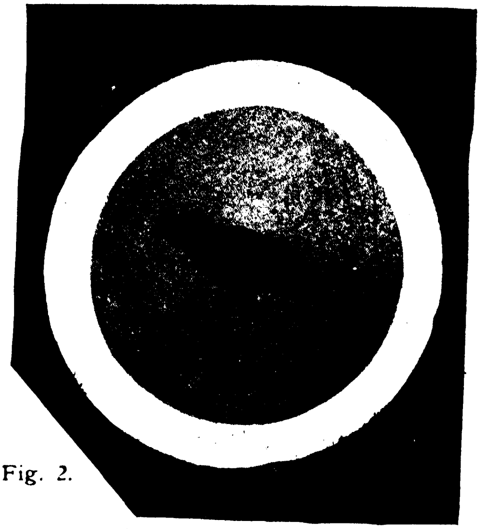


Fig. 2.

DANISH SHIELD

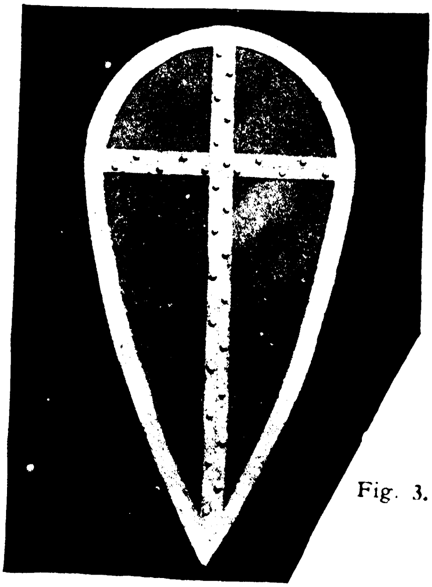


Fig. 3.

NORMAN SHIELD

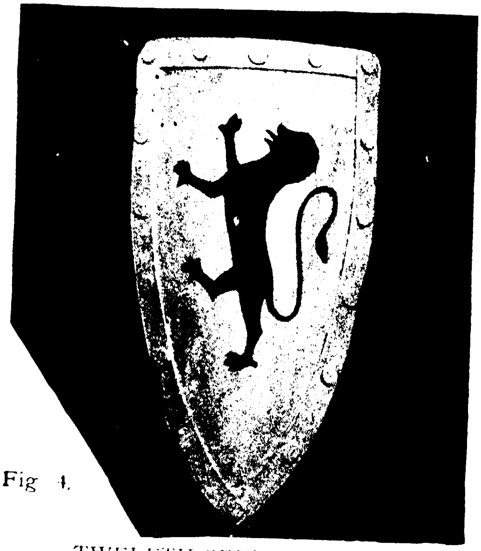


Fig. 4.

TWELFTH-CENTURY SHIELD

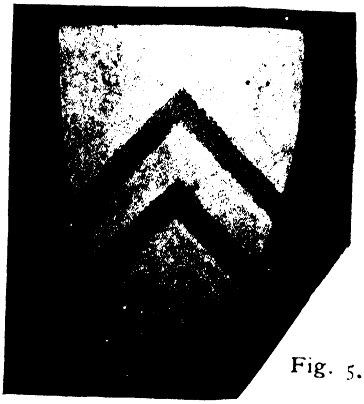


Fig. 5.

THIRTEENTH-CENTURY SHIELD

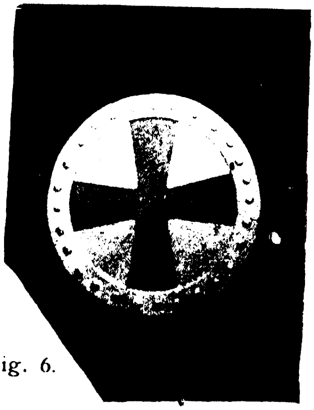


Fig. 6.

FOOT-SOLDIER'S SHIELD

SHIELDS

first cut out, and the opening in the end is made with bit and saw. These parts are afterwards nailed together and the roof added. The wheels, which are made with a disc-cutter, turn on screws or round nails.

The Balista.—The balista (Plate XX., Fig. 3), like a huge cross-bow, cast its bolts point blank.

A stout piece of wood forms the base of the model. The two upright pieces at the end are half lapped to the crosspiece and to the base, and are glued and nailed in position. Two screw hooks in the base and two in the ends of the top crosspiece carry twisted cords like a bow-saw, into which are inserted two pieces of flexible wood such as cane. These with an intermediate string form the bow. To the middle of this string another piece is fastened, which, passing through a screw eye at the rear of the base board, is used for drawing the bow.

The Trébuchet.—The trébuchet (Plate XX., Fig. 4) consisted of a balance with a long beam, one end of which was heavily loaded. The other end was drawn down and held till the missile was placed, and on being released, the missile was thrown forward in a high curve.

The base frame consists of three pieces of $\frac{3}{8}$-in. wood. The crosspiece is half lapped into the other two, to which are nailed the two upright tapered side-pieces. A thick piece is nailed between the vertical sides to steady them, and the two sloping pieces between the base and the sides are for the same purpose. The beam is tapered and is modelled with a knife. A pricker hole is made through the beam, and a round wire nail passes through this, as well as through two screw eyes, driven into the top edge of the vertical sides of the model. This acts as the fulcrum. At one end of the beam is a weight, such as a nut or piece of lead, and at the other is an arrangement of partly driven nails to hold the missile. A screw eye and cord with which the beam is drawn down is also added.

The Siege Tower and Ram.—The siege tower (Plate XX., Fig. 5) was the most effective of the weapons of attack. After the moat had been filled with bundles of twigs, the tower was moved towards the wall, the bridge was dropped, and a column of men was thrown against a thin line of defenders.

The model is made of ¼-in. wood. The body consists of two tapered sides, one crosspiece overlapping the sides at the top, one crosspiece between the sides on a level with the bridge, and another crosspiece lower down to which the ram is slung. These are all nailed together. Strips are nailed to the lower edges of the sides, and to these the wheels are attached. To the front is nailed a shield, pierced by an opening through which the ram may swing freely. The back is open and is provided with a scaling ladder made of ¼-in. square wood. Two pieces of wood stand vertically on the second shelf from the top, and are nailed to the sides and to the top shelf. They are pierced for the thin cord used in raising or lowering the bridge. The bridge is on the same level as the second shelf, is rounded on the inner edge, and is hinged by using screw eyes and round nails. The ram, heavily armed at the working end, is suspended from the lower shelf by string passing through screw eyes.

The garrison of a besieged castle defeated the work of the ram by lowering battened timber in front of it to distribute the force of the blow over a wider area.

The engines of attack might be arranged round the model of the keep to form a tableau.

The Rise and Decline of the Shield.—The bronze shield of the Celts and the wooden targets of the Anglo-Saxons and Danes were all circular in shape, and offered little protection to the legs. To secure such protection the Normans, while retaining the semi-circular top, extended the lower semi-circle, bringing it to a point, and produced the kite-shaped shield so popular with the invaders during the eleventh century. About the twelfth century the semi-circular top was modified, and the curve either became much flattened or else it was replaced by a straight line with the corners only rounded.

As a result of the Crusades more efficient armour was introduced, and the greater protection which it gave to the legs caused the shield of the thirteenth century to be made much smaller. It has a perfectly straight top. Later the dimensions were still further reduced, and, after being carried for a time as a mere ornament, was eventually discarded altogether.

The Anglo-Saxon Shield.—The characteristic feature of the

Anglo-Saxon shield was the umbo or central metal boss, which, coming to a sharp point, was used for offensive purposes at close quarters. The shield was of wood covered with leather and measured about 3 ft. in diameter. It was flat or convex on its outer surface, and was strengthened by radiating strips of metal. It was carried in the hand.

The shield illustrated in Plate XXI., Fig. 1, is nearly true to type. The back is of ¼-in. wood with a circular hole in the centre. On either side of the hole and across the grain a batten is added to carry the handle to be fixed later. The face is covered with thin leather board with a hole in it corresponding to the hole in the wooden back, glue being used as an adhesive. A circular piece of thin flexible card, cut along one of its radii, is folded sugar-paper fashion to form the conical umbo. This, after being glued up, is passed through the hole in the shield, but about half an inch is left protruding at the back. A number of scissor cuts allows this half-inch to be laid down on the wooden back of the shield, where it is glued. The collar round the umbo, the radiating strips, and the outer rim are then applied. The studs are small paper fasteners pressed into pricker holes after their ends have been dipped in glue. The handle is now added at the back, so that the knuckles of the user fit up into the hollow of the umbo. The metallic parts of the shield receive an application of aluminium paint.

The shield can be made in a similar way without the wooden back; and a large one, for dramatic purposes, can be made from the top of a butter barrel or cheese box covered with leather board and studded with hobnails.

The Danish Shield.—This was of the same shape, and about the same size as that carried by the Saxons. It was likewise of wood covered with leather, and was either flat or convex on its outer surface. That illustrated in Plate XXI., Fig. 2, is convex. To make it, procure a circular piece of leather board, and having cut it along one of its radii, draw one of the edges formed by the cut under, and the other over the card, and so make a flat cone. Apply an adhesive and hold in position by means of a paper fastener till the glue sets. The rim is subsequently added, paper fasteners inserted as studs, and a coat of aluminium paint applied.

The raven is cut out of black paper and stuck to the centre of the shield. A handle of cardboard is applied at the back.

The Norman Shield.—The Norman kite-shaped shield, like that carried by the Saxons, was made of wood with a leather covering. It was either flat or curved, and usually measured about 4 ft. long and 2 ft. wide. The owners decorated their shields so that they would know them, and they, in turn, became known by the decoration on their shields, and so an impetus was given to the rise of heraldry.

The same method as is adopted in making the model of an Anglo-Saxon shield is adopted in making that illustrated in Plate XXI., Fig. 3. It has a back of $\frac{1}{4}$-in. wood which is covered with thin leather board, but the wooden back is not essential and may be dispensed with. In either case, near the diameter of the semi-circular top at the back of the shield, a piece of tape should be fixed to form an armlet, while at a convenient distance lower down, another piece should be fixed to be gripped in the hand.

The Twelfth-century Shield.—The twelfth-century shield (Plate XXI., Fig. 4) is curved. A piece of cardboard is cut to the required shape, and the rim and studs, which are small discs of card, added. Two pieces of wood are taken, and one edge of each is cut to a curve, and the cardboard shield nailed round these curved edges. To prevent twisting, two other strips of wood are placed across the two former pieces and nailed to each. An armlet and hand loop are added, as in making the Norman shield. A coat of aluminium paint, followed by the addition of the heraldic decoration, completes the model. The smaller shield (Plate XXI., Fig. 5) is made in the same way as that just described; while the method adopted in constructing the foot soldier's shield (Plate XXI., Fig. 6) is identical with that employed in making the one used by the Danes.

Helmets.—The Britons usually fought with bare heads, their long hair streaming in the wind, and though bronze helmets have been discovered, it is probable that such were not in common use.

The Anglo-Saxon helmet was a strong leathern conical cap, which in later times was strengthened with metal ribs or covered with mail or imbricated plates. To this the Normans added the nasal, the object of which was to shield the eyes and brow from a slashing cut.

From 1100 the evolution of the headgear followed two different paths. The knight in armour, especially when equipped for the tournament, found that the mere cap with the nasal offered insufficient protection, so he covered his head and neck with a large iron pot which rested on his shoulders. On the other hand, the desire for a better defence than that afforded by the steel cap, and a less cumbersome one than the great helm, led to the improvement of the former, and finally resulted in the production of the bassinet, which was the battle head-dress of the nobles, knights, and sergeants of the fourteenth century. Its development from the Anglo-Saxon cap is readily seen.

The Bronze Helmet.—The bronze helmet (Plate XXII., Fig. 1) is made of three pieces of flexible card. The piece for the cap is rectangular in shape and long enough to encircle the head. The lower portion of the rectangle is left untouched, but the upper part is cut into eight pointed sections with flanges, which are brought in to meet at the top, a powerful fixative being used to fasten them together. The horns are cones developed from sectors of circles, and are fixed in position on the top of the cap by notched flanges. A coating of bronze paint is subsequently applied.

Anglo-Saxon Helmet.—The Anglo-Saxon helmet (Plate XXII., Fig. 2) is made of thin leather board, and, being conical in shape, is developed from a circular piece of cardboard. It is strengthened by a band of metal round the base and four straps running to the apex. These are made of card painted with aluminium paint and fixed in position with small paper fasteners. The metal decoration on top is cut from thicker card and fixed in position by means of a tail piece passing through a hole in the apex of the helmet. The chin strap is tape held by two of the paper fasteners. The boar's head, a charm, is cut from coloured paper and applied to the front.

The Danish Helmet.—The Danish helmet was a closely fitting skull cap of leather with a pair of horns or wings projecting from the sides. It can be made in the same way as was followed in constructing the bronze helmet, or, for dramatic purposes, the crown of an old felt hat may be used.

The Norman Helmet.—The Norman helmet (Plate XXII., Fig. 3) is made in exactly the same way as the Anglo-Saxon one previously described, excepting that the nasal is added and the top ornament and boar's head omitted.

The Cylindrical Helmet.—This style of helmet (Plate XXII., Fig. 4) was used in the twelfth century. It was flat topped and had a wide band to protect the neck. It was hardly cylindrical, as it tapered slightly from the top.

A rectangle of card long enough to encircle the head, and proportionately broad, is used to form the curved surface. The top edge of this is notched and flanged, and carries the circular top. The chin band is developed from a circular ring of card, and this, together with the rim and vertical strip, is stuck in position; after which the whole is given a coating of aluminium paint.

The Cylindrical Helmet with Movable Ventail.—This helmet was common in the thirteenth century. It was a further development of the one previously described.

The model (Plate XXII., Fig. 5) is in three parts. The body is a cylinder large enough to pass down over the head, and is notched and flanged on the upper edge to receive the top. The top is a flat cone developed from a circle in the same way as was described in making the foot soldier's shield in another section. In the front an opening is cut, over which a cover is hinged. The cover is provided with slits and is hinged to the body with a piece of book-binder's cloth. The strengthening strips are added in the usual way, and afterwards aluminium paint is applied.

The Bassinet with Visor.—The body of the model illustrated in Plate XXII., Fig. 6, is in two parts notched and flanged together. Shape is given to it by making a number of cuts from the base towards the top and pleating the sections over each other, and also by pressing into the crown a thick piece of card cut to the desired shape. The body is cut away at the front, and the opening covered by the visor, which is developed from one piece of card and roughly takes the form of a triangular pyramid. After sight and breathing holes have been cut, the visor is hinged to the helmet by means of a couple of paper fasteners, and the whole then receives a coating of aluminium paint.

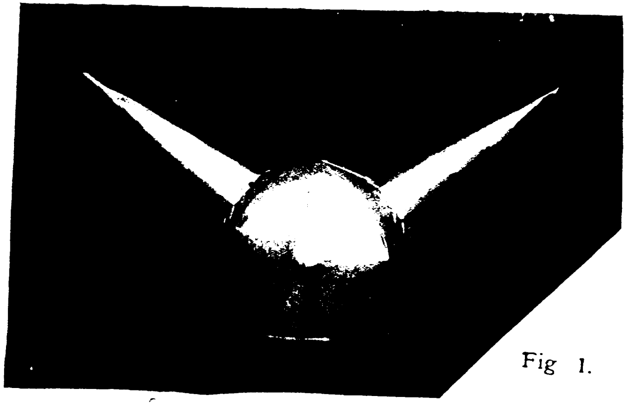


Fig 1.

BRITISH HELMET

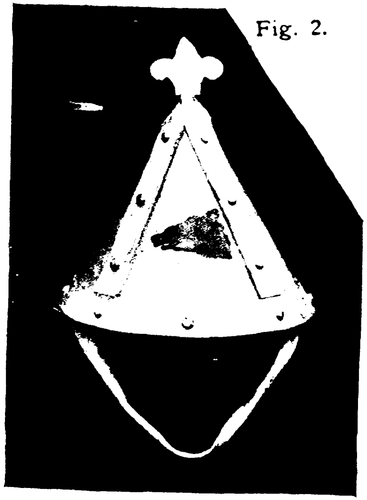


Fig. 2.

ANGLO-SAXON HELMET

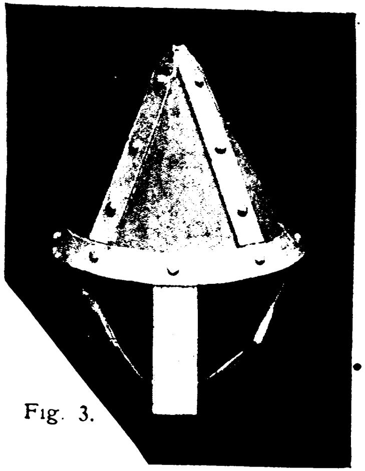


Fig. 3.

NORMAN HELMET

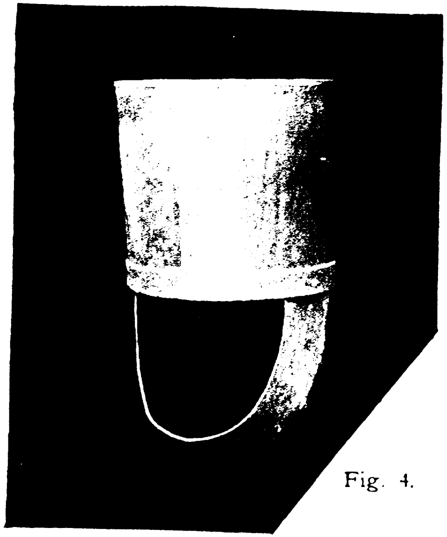


Fig. 4.

CYLINDRICAL HELMET

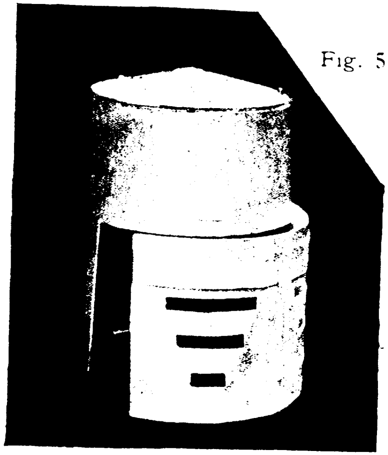


Fig. 5.

THIRTEENTH-CENTURY HELMET

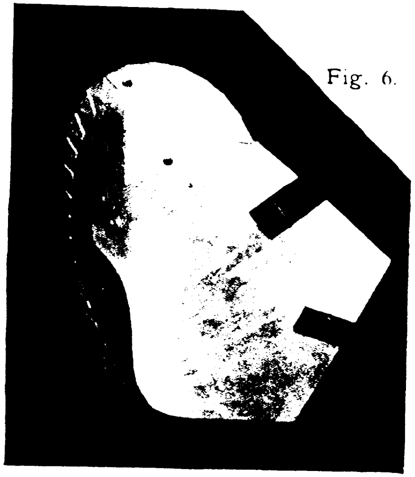


Fig. 6.

BASSINET WITH VISOR

PLATE XXIII

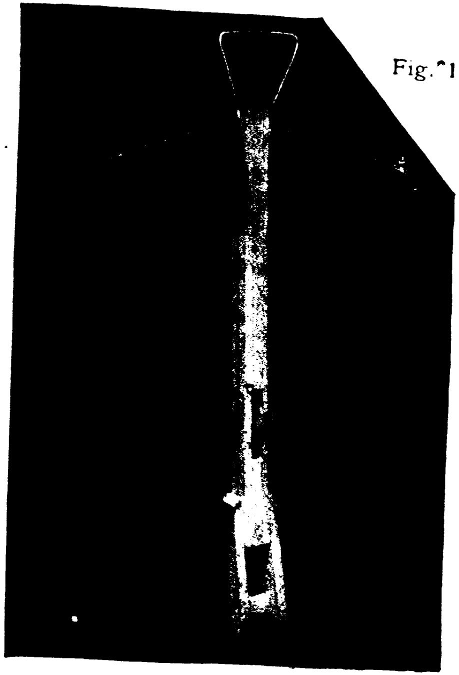


Fig. 1.

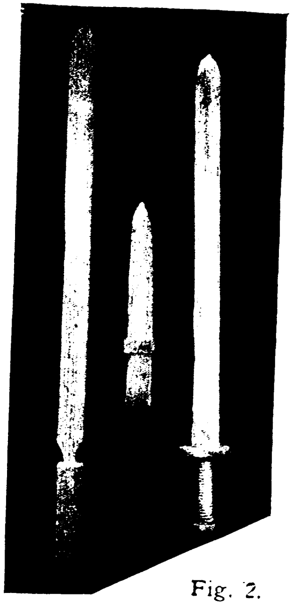
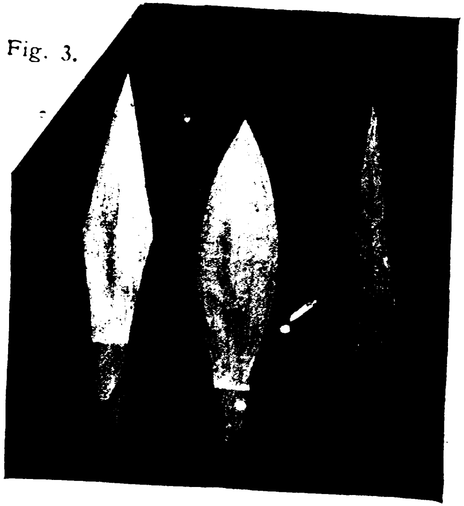


Fig. 2.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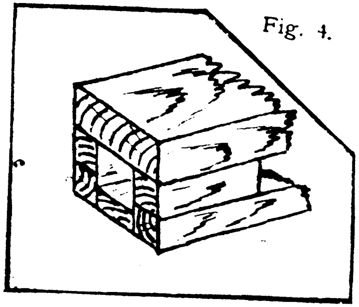
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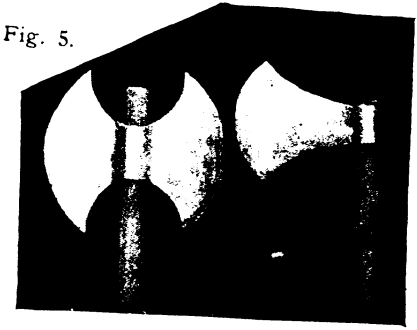
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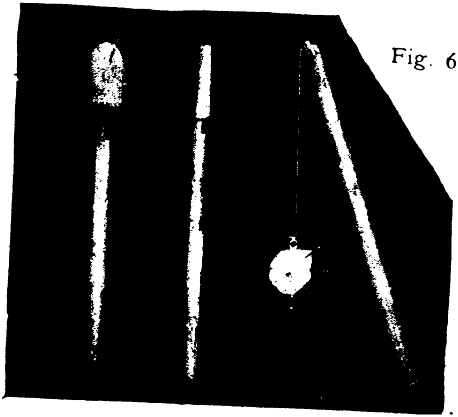
Fig. 6.

OFFENSIVE WEAPONS

S.H.

Offensive Weapons.—Space will not allow a full description of all the offensive weapons used in the period under consideration, so examples of each class are taken as types. They may be divided into three classes: weapons for stunning or crushing, like the club; those for piercing, like the arrow or spear; and those for cutting, like the knife and sword.

The Club.—The club used by Palæolithic man probably consisted of a sapling or branch of a tree, while during the Neolithic period a stone was lashed into a forked branch to serve the purpose. The same weapon in more highly finished form was used by both Saxon and Norman at the battle of Hastings, and afterwards the efficiency of the weapon was increased by the addition of spikes, chains, and detached heads. The mace, the symbol of authority, and the policeman's baton are modern survivals of the club.

The Morning Star.—The club with the spiked head seen in Plate XXIII., Fig. 6, was in use in the later Norman period. The model is whittled with the knife and afterwards finished with file and glass paper. Oval wire nails are partly driven into the head to represent spikes.

The Military Flail.—This weapon, illustrated in Plate XXIII., Fig. 6, and sometimes called "The Holy Water Sprinkler," had its inception among the implements of husbandry. The shaft of the model is made with the knife, and the head is a cube with its corners taken away. A screw eye in both head and shaft, together with a piece of string or chain, is used to attach the two parts.

The Battle-axe.—The battle-axe of the Stone Age was a flint lashed to or fixed through a hole in a wooden shaft. The later Celts wedged a branch with a knee-bend into the socket of their bronze weapon; while the Anglo-Saxon iron-headed axe, in which the form of the bronze celt is plainly visible, was more like our tool. A long-handled battle-axe was used somewhat sparingly by the Normans, and in mediæval times numerous fantastic types arose, such as the halberd and pole-axe.

The Saxon Battle-axe.—The head of the model of the Saxon battle-axe seen in Plate XXIII., Fig. 5, is made of thin leather board. It is in one piece bent round the shaft and glued along the cutting edge. To prevent the card fracturing when bending, a number of scored lines may be made on the bending part. The head is nailed to the shaft, which consists of a portion of a broom shank.

The Danish Bipennis.—Two equal correctly shaped pieces of card are used to make the model seen in Plate XXIII., Fig. 5. They are glued at the cutting edges, and when dry the shaft is slipped between them, and tacks used to hold the head in position. Aluminium paint is applied. Other axes may be made in a similar way.

The Spear, Lance, and Javelin.—The earliest form of the spear was a slender pole sharpened at the end to which metal points of bronze, iron, or steel were subsequently added. The Anglo-Saxons had a long spear for use by cavalry, and a shorter one for use as a spear proper or a javelin—both kinds had ash handles. The Norman lance head was usually leaf-shaped. In the days of chivalry the lance was embellished. The banner, twice as high as broad, indicated superiority of command. The pennon, with two or more tails, was carried by an ordinary knight; and the esquire was entitled to use the small, narrow streamer known as the pennonçel. The blade of the spear was much modified in later times. The bayonet is its modern representation.

Anglo-Saxon Spears.—A lozenge-shaped and a leaf-shaped spear are shown in Plate XXIII, Fig. 3. They are both made in the same way. Two pieces of card of equal size and shape are cut, scored along their major and minor axes and glued together at the edges. A small piece of wood is afterwards thrust between them, so producing the thickness of the blade. The lower end of the head is slipped into a saw-cut made in the end of a broom stick which serves as a shaft.

Norman Spear.—The Norman spear illustrated in Plate XXIII., Fig. 3, is built up and modelled with the knife. The head is made from three pieces of ¼-in. wood nailed together and whittled to shape. Care must be taken that the nails are placed in such a position that the whittling will not be hindered. The shaft is made in much the same way, and the two are attached by an open mortise and tenon joint arranged in the following manner: In making the head the middle piece of wood is extended to about 2 in. at the shaft end, and so forms the tenon; while in making the shaft the middle piece is made about 2 in.

shorter than the side pieces, thereby producing a mortise. The banners, etc., previously mentioned should be made in some material and added to the shaft just under the blade.

The Bow.—The origin of the bow is lost in antiquity. Primitive man would use a plain or self bow composed of a branch strung with sinew or hide. The bow-stave was subsequently modelled, and to give greater driving power the stave was built in layers. The cross-bow, a further development, was supplanted by the long-bow, because of the time occupied in loading the former.

The Cross-bow.—A cross-bow is shown in Plate XXIII., Fig. 1. The barrel is built up as shown in Plate XXIII., Fig. 4. There is a top piece $18 \times 1\frac{1}{4} \times \frac{1}{2}$ in., two bottom side pieces $18 \times \frac{1}{2} \times \frac{3}{8}$ in., two base pieces between these, $\frac{1}{2} \times \frac{1}{4}$ in. and of such a length as will leave room for the trigger. There are also four separating pieces between the top and bottom, each $1\frac{1}{2} \times \frac{3}{8} \times \frac{1}{4}$ in., which leaves a slot for the cord. These parts are nailed together, and the handles added. The trigger, bearing a notch to receive the string, turns on a round wire nail. The bow is a piece of cane held in position by two screws. The wire stirrup is used in drawing the bow, and is fixed by two wire staples.

Norman Sling.—In Plate XXIII., Fig. 6, is a sling. The shaft is whittled, and to it is nailed a strip of leather bearing a ring at the loose end. The ring slips on to the tapered end of the shaft, and in the loop so formed the missile is placed.

The Sword and Dagger.—The evolution of the sword is so doubtful, and the weapon takes so many forms, that it is not possible to deal with it fully in this article. Two of the earliest forms only are dealt with.

Anglo-Saxon Swords.—In Plate XXIII., Fig. 2, is illustrated the earliest form of Anglo-Saxon sword. It is in two parts, the haft and the blade, the latter being tanged. The blade is whittled from $\frac{1}{4}$-in. wood, and the handle is built up from four pieces of the same material, a hole being left to receive the tang of the blade.

The shorter sword seen in Plate XXIII., Fig. 2, is made in the same way as that just described, but is cut square in section where the tang joins the blade, so that the hand guard slips accurately into position. The guard is shaped with the knife, the hole is bored with brace and bit and afterwards squared with the chisel. The small knob at the other end of the haft is made in the same way and nailed, after which the haft is wrapped.

The Seax.—In Plate XXIII., Fig. 2, is a model of the weapon from which the Saxons took their name. The model is whittled from a single piece of wood, and has one cutting edge only.

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XLVI. COLOUR WORK FOR INFANTS

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Some Aims in Colour Training.—This article includes every kind of colour training that is suitable for use in schools for children under eight or nine years. Not only does this embrace such work as painting and chalking, but also colour games and colour activities of all kinds.

Before going into any detail, it is well to consider colour training as a whole, and to realise in some degree its aims, in order that we may be led to a wise choice of activities and sound methods of procedure. All healthy and sound methods must be based on principles which are deduced from our own and other people's experience and knowledge of children. Much time is often wasted by those who adopt methods without seeking first the principles which underlie those methods. It is most necessary that every teacher should understand the "why" of everything she does, so that all ideas gained from outside sources may become her own. By going to the root of the matter at once she may be able to grasp and appreciate the aim and end of all she undertakes, and will be guarded from making the mistake of suiting the children to her methods instead of her methods to the children.

(1) *To Cultivate Art for Life's Sake.*—Although there are many minor aims in including colour work in the kindergarten curriculum, which vary according to the children with whom we deal, yet there is one at least which is universal, and which is the very foundation of all colour work with young children. It is the appeal to that side of the child which responds to anything beautiful, anything pure and strong, and the developing of this so that the child's whole life may be influenced for good.

A true instance may serve to illustrate how greatly worth while it is to cultivate the sense of colour. A man went out into the country with an artist. "What colour are those tree trunks?" said the artist, pointing to trees in the distance. "Black." "And that fence?" "Black." "They are the same colour, then?" "No," said the man, "they cannot be; because the tree shows up against the fence. The tree is darker, and the fence, after all, looks quite a pale grey to me now, although I know it is painted black." In a short time and after a few more comparisons the man saw the colours not as they were, but as they appeared to the eye when looking at them in that particular sunlight. This man returned to appreciate many sketches which before he had criticised as over-coloured, and greatly to deplore the fact that he had passed by many of the beauties of nature through lack of having his sense of colour trained when younger. This is one instance, but many hundreds of people would be able to appreciate the beauties of their surroundings if they had only been taught how to look at nature with a seeing eye.

It is not only amongst artists that we should be able to look for those who can beautify our surroundings, but in the everyday working world, amongst business men, workmen, people who have nothing to do with art as a profession. These can all help in the struggle for harmony, unity, and beauty, especially in their own homes. It is very necessary, then, if we are aiming at the lifting up of the race through the cultivation of the sense of beauty, that art training should be begun early, since a young child is a most impressionable being and eager to learn. It is not sufficient that, in order to cultivate the æsthetic side of the child, he should have a paint box and a few lessons in painting; he must also see his growing ideas carried out as far as possible in his surroundings.

In the class-room the children should be encouraged to make everything as beautiful as it can be—the general order, the arrangement of flowers, or the decoration of the doll's house. All these things, if carefully supervised by the teacher, will help to give a feeling of comfort combined with beauty, and to create an atmosphere of unity, fitness, and harmony.

The aim, then, of teaching colour work is not to try to make artists of all children, but rather to broaden their outlook on life, to help them to take pleasure in the beautiful things around them, thus inevitably blocking out as much as possible those things which are distasteful and ugly. In short, the aim is to cultivate art, not for Art's sake *only*, but for Life's sake. "Art has a double mission. It has a material and a spiritual duty to fulfil. Its material duty is to make and decorate useful things; its spiritual business is to remind us that man does not live by bread alone—to bless our toil by perpetual promise, and to make its exercise a pleasure instead of a pain" (*Arbor Vitæ*, by Godfrey Blount).

(2) *To Prepare for Later Art Work.*—Although colour work as taken with infants is of a very elementary nature, it should nevertheless help to form a lasting foundation for the continuance of the study of art in the child's later years at school, and, notwithstanding the fact that it is of little or no importance whether he will become an artist later on or not, yet it is of paramount importance that he be given an opportunity of giving expression to any latent talent within him. All children should be taught colour work as a matter of course, just in the same way as they are taught reading and writing. Some will excel more than others, but that is the case in every subject. The great majority of children will not become artists, but *all* of them, if they have begun early enough, will, when they are older, be lovers of art, if not doers of art.

If, when a child goes into one of the junior forms, where the children are about ten or eleven years of age, he has had some experience in colour work, either painting or chalking in the kindergarten, he will more quickly develop and appreciate things than a child coming into the form without having had any previous training. The latter will probably find himself behind the rest of the class through absolutely no fault of his own, and will very likely be discouraged in consequence.

From an art teacher's point of view, also, it is impossible to over-estimate the advantage of continuing the training of children who have had good previous all-round experience in colour work. Another aim, then, is to lay a good foundation for later art work.

Some Principles underlying Colour Training. (1) *Spontaneous Activity.*—Long before a child goes to the kindergarten or infant school he should have had incidental colour training in the nursery. A careful mother will begin to develop the colour training at the first sign of her baby's spontaneous delight at seeing a coloured ball or toy. All young children love colour, especially bright colours, and should be given coloured toys to play with, so that they may play quite freely. It will be noticed in almost all cases that a child will soon stretch out his hand for the most brightly coloured toy, perhaps an orange or red ball, which shows that through his own activity he has already learned to discriminate between one colour and another.

The importance of these things is often overlooked by casual observers, but they are real steps to progress in a child. Every child must make a beginning, and the real beginning is generally not made at school, but at home through the child's own spontaneous self-activity. The teacher then takes up the threads, and by carefully watching and following the child, helps to further cultivate his love of colour by placing him in the right surroundings and giving him suitable materials with which to express his ideas.

(2) *Correlation.*—With young children whose experience is still quite small it is most important, if the children's work is to be spontaneous and the outcome of interest, that their work should be correlated with what is familiar to them. This means that the teacher must take into consideration some of the following questions.

(i) *Environment.*—Is the school in the town or country? What appeals most to town children, to country children; and what is worth cultivating?

(ii) *The Home.*—Are the children poor or rich? Do their lives need brightening? Have they the opportunity of seeing beautiful pictures or of seeing a room simply yet artistically arranged? What kind of training will best develop the æsthetic side of their nature?

(iii) *Time of Year.*—What do they see out of doors when coming to school? What changes are taking place in the world of nature—flowers, birds, trees, landscape, sky effects in town or country?

(iv) *Curriculum.*—What other subjects are they learning in the kindergarten or infants' school? How can their colour work be correlated with these subjects in order that there may be unity in their training?

The replies to these questions should be a great help to the teacher in planning her schemes, and of paramount importance to the children if their colour training is to be based on a firm foundation and is to form a real and vital part of their life.

This principle of correlation links colour training on to life in general, and leads on to another important principle which will be dealt with now.

(3) *Connectedness.*—Just as it is necessary to proceed from the known to the unknown by correlating the colour work to the children's environment, homes, the seasons, and their other work, so it is also necessary to proceed gradually in the actual working out and developing of colour work as a subject. This means that the teacher must first begin by thinking of the *children.* What do they know of colour? What experiences have they already had with any kind of colour work? What kind of colour activities do they need in order to develop further those ideas already gained?

It may not be necessary or even possible to correlate the colour work with the other subjects—although this is excellent if it is not unduly forced—but it is sometimes a very good plan to have a short course on colour in order to interest the children in colour itself in a simple way; in any case, all the colour exercises should be graduated according to the child's development.

(4) *Individuality.*—This is a principle that applies both to the teacher and to the child.

(i) *The Teacher.*—If a teacher is to throw herself heart and soul into her work she must be thoroughly well initiated into her subject, for unless she is master of it she cannot have the power of *choice.* She will be bound, as unfortunately many teachers are, to follow the methods of somebody else, and by so doing she loses her individuality and her lessons will lack spontaneity. On the other hand, if she herself works out carefully all the things she intends giving the children, and bases her methods on sound principles, she will be free and will have confidence in what she does.

A lesson which blindly follows a set method not fully understood by the teacher deadens the life and vigour of a class, especially if the children are forced to do exactly what the teacher has planned for them, even if they suggest small divergencies which do not alter the main aim, but only show a sign of individuality. On the other hand, a lesson given by a teacher who teaches not because she has to teach something, but because she has something to teach, will be full of life and vigour, and the children will realise that they have somebody with them who understands their ideas and encourages them to express those ideas in their own way.

(ii) *The Children.*—It is in the training of colour work that a child's individuality is more developed, perhaps, than in any other subject. This is evident, because if a child is well guided he will have ample opportunity of self-expression, which is, so to speak, a kind of language to a child. It is by watching the children and observing the results of their work that a teacher can find a key to a great deal in the child's character and temperament. For instance, she can find out which children are most artistically gifted, which have most original ideas, which appreciate form, and which love colour, and often, from their designs or patterns, she may find out which of them are mathematically inclined. It is absolutely necessary, then, both for teacher and child, that the children be given ample opportunity for original work.

(5) *All-sided Development and Variety.*—Nobody, whether grown-up or child, cares to have the same thing to do and the same way of doing it day after day, be it what it may, nor is it good that any one should work in a groove, although some occupations are inevitably monotonous. But with children it is unnecessary and very bad to pin them down to one particular way of expressing their ideas. There is a vast variety of material and a great many ways of working out ideas in colour, and it would be a great pity to neglect them. Colour work does not mean painting flowers only, nor chalking pictures only, nor making patterns only—it means all of these and many other similar activities. Children must be trained to have a broad idea of colour work, and to realise that it is not an isolated subject connected only with brushes and tubes of paint or boxes of chalk.

If we are to develop this principle of all-sidedness, it is necessary to have as much variety in connection with colour work as possible, so that the children may realise its broadness and possibilities. This is done by having as a foundation the principles of correlation and connectedness, which enable the children to realise the connection between colour work and their other subjects, their environment and their life. Methods working out these principles will be found later in connection with the illustrations.

Stages in Development.—Before going into any detail on methods and types of colour exercises, it is necessary to mention that there are three distinct stages through which a child passes.

I. The stage of Desire.

II. The stage of Technique.

III. The stage of Power. (This will not be dealt with, since it does not come under the heading "Colour Work for Infants.")

I. **THE STAGE OF DESIRE.**—Anybody who has had much to do with the training of very young children, and who has watched a child paint or chalk, will have noticed that he paints *first* from sheer love of activity, liking for colour, and the *desire* to express something, somehow. He is not in the least worried about the result, nor does he even seem conscious that it does not resemble to any considerable extent what it is meant to. He has not yet attained the stage when he can copy anything, such as in representing a flower from nature, which involves observation, assimilation, the forming of a good concept, and expression.

All small children begin by painting from idea, or, as we generally say, from memory. Their expressions are the result of spontaneous activity of the desire to express or communicate their idea with the means at their disposal. From these small beginnings the whole of their future colour training may be developed.

The colour-work lesson at this stage, when the child is three or four years old, should aim at giving the children: (1) An opportunity of expression to fulfil their desire for activity; and (2) Practice in arranging and combining colours.

(1) **Expression Work.**—This includes: (*a*) Spontaneous colour work. (*b*) Free illustrations of stories, nature work, etc. (*c*) Representations of objects of interest in connection with home and environment.

(*a*) *Spontaneous Colour Work.*—It is hardly necessary to describe the types of things that are done by babies of three and four years when they first begin. Everybody who is interested in the development of children must have seen the chalkings or paintings of trees, people, engines, animals, etc., which are hardly recognisable until they are described by the child, to whom they mean far more than they can explain in their baby language. Much of this kind of work will be done at home, and often brought to school for the teacher to look at. The children should be encouraged to do this, for it is a means of connecting their home and school life. In giving lessons of this kind, however, the business of the teacher is to furnish the children with sufficient material, and then to let them express themselves quite freely. At the end of the lesson the children may be encouraged to tell the story of their picture, to say what they have drawn, and when and where they have seen it. This gives the teacher an insight into much of the child's nature, surroundings, thoughts, interests, ideas of colours, and capability of expressing themselves by means of coloured pictures.

On Plate XXV. are shown types of this kind of free work done at school in the kindergarten. Two of these are productions of children of four years. The first was done by a small boy, and it is interesting to notice that he has chosen an engine, thus showing the type of object in which he is probably most keenly interested. He has put great life and strength into his drawing by the strong colouring of both engine and fiery smoke and in the signal. The whole picture indicates strength and movement.

On the other hand, the little girl, the originator of the three figures on the same plate, has depicted people, showing that she is probably more interested in living things. She described her drawing as a man (the figure with the red legs and green coat), a woman (the figure with the red coat), and a child (in the blue coat).

This kind of exercise—*i.e.* free colour work—in chalk or paint may be given fairly frequently to young children in the kindergarten or infant school, and it must be kept in mind that it is of little consequence at this stage whether the result as a drawing be good or not. The result in the *child* is valuable: he is learning much; he is gaining experience all the time, and will gradually gain more power to express his ideas, just as a child in learning to read develops gradually.

The chief values, as regards colour, of this kind of work with babies are: (i) They have entire choice of colours. (ii) They have freedom in arranging, grouping, and combining colours. (iii) They gain experience in manipulating their materials. (iv) All these combine to give the teacher a key to the children's interests, powers of expression, ideas of colour—in short, to their natures and the extent of their development.

(*b*) *Free Illustrations of Stories, Nature Work, etc.*—Illustration as a means of expression of ideas gained in other subjects should play a very great part in the kindergarten scheme; in fact, it is invaluable from the point of view of colour, no less than as a means of helping to clarify the children's ideas.

In all true kindergartens the children are told stories at least once or twice a week, and when the children are quite young, say three or four years, the stories are short, simple, and connected with something with which the children are familiar—their home, environment, the seasons, and so on. A good story is generally full of coloured descriptions which at once catch the children's attention and arouse their interest, so that they have a mental picture of what they are hearing. It is this mental image which they try to represent in their free illustrations.

Take, for instance, the story of the "Ugly Duckling." What a wealth of colouring could be put into it to make it vivid to the children! The farmyard scene with its green meadows, blue pond, deep blue summer sky. The white duck with her yellow beak, and the little fluffy yellow ducklings and the one grey baby bird. The hens and chickens, the cock with his red comb and brightly coloured feathers, and the many other farmyard creatures.

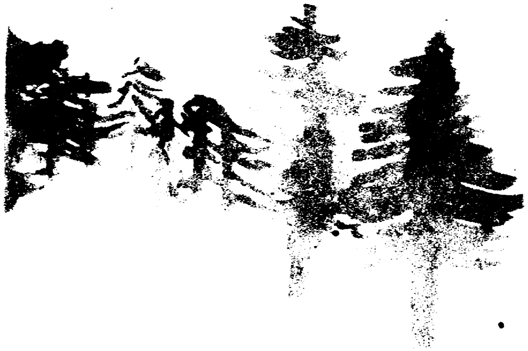
Or, again, take the story of the "Fir Tree." First the beautiful dark green wood, and the white snow on the ground in winter time with the blue sky above; then the contrast from the quiet scene of nature to the gay scene in the house to which the fir tree has been taken. The coloured candles, lights, apples, toys, and the glittering fairy at the top, surrounded by children in party frocks enjoying the brilliance of the scene. If these stories are told well with plenty of references to colouring the children will only be too ready to express their mental pictures in colour. On Plate XXV. is an example of the expression of the mental picture gained by the first part of the story of the "Fir Tree," showing the cool winter scene and the fir wood. The next picture shows the last part of the story. It represents the Fir Tree in its gay attire, with the coloured candles and the fairy at the top. The child explained that she had speckled the fairy with blue to make it glitter. The figure at the side is meant to represent herself in party dress.

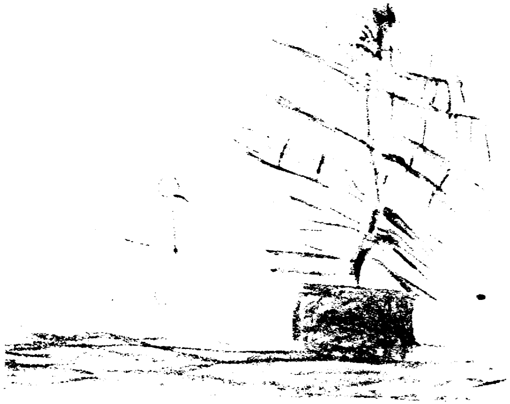
METHOD OF TAKING THESE LESSONS.—If the illustration lesson comes immediately after the story, the children need only to be supplied with materials, *i.e.* paper, paints, or chalks, and allowed to draw quite freely, each choosing to illustrate the favourite part of the story. At the end of the lesson the children may be encouraged to describe what they have done.

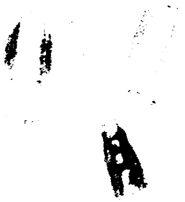
If, however, the children are illustrating a story which they have heard a day or two before, they will need a short revision before beginning to draw. This takes the form of a short dialogue, bringing out the most important points of the story, not forgetting the colours of various things mentioned—to help them in their expression. The lesson then proceeds as before.

There are many other lessons which give excellent scope for expression work in colour. At the end of, and in connection with, nature lessons the children may often paint or chalk what they have been observing—plant life, coloured leaves, bulbs, trees, seedlings, etc., or animal life, sometimes in connection with the aquarium, tadpoles, goldfish, and so forth. The results of these illustrations, if the children are only three or four years, will often be almost unrecognisable; but at this stage all things seem of equal difficulty to the child. He is willing to attempt anything because of his desire for activity, and he is always happy with the result, for it means much to him, if to nobody else. He has, in any case, gained some sort of experience and defined his ideas.

If not much time can be allowed in the curriculum for such expression work, a good medium to use is chalks. These do not need much apparatus, and are quickly given out and collected, and may be often used at the end of a nature lesson. If, how-







EXAMPLES OF SPONTANEOUS COLOUR WORK

ever, a whole lesson can be devoted to expression, then paints may be used. It is well to vary the material according to the type of expression and amount of time allowed. No fixed rule can be made, therefore this must be left to the teacher's discretion.

(c) *Representations of Objects of Interest in Connection with Home and Environment.*—Small children are very fond of bringing their toys to school, if they are in the least encouraged to do so. These toys are a source of interest to the child, and are, therefore, good objects to choose for painting. They are also valuable because they are, as a rule, large and bold, and it is advisable to give large, bold things to a tiny child to paint, for these reasons: (i) It develops the large muscles of the child's hand and arm. (ii) It gives him experience in manipulating his brush and paints in a good, free way. Any very fine work is bad for a small child, and is to be avoided, since a young child's eyes are not fully developed and should always be carefully considered. (iii) It teaches him colours in a simple, interesting, self-active way.

On Plate XXV. is shown the work of a child of two and three-quarter years. It is supposed to represent a toy dog on wheels. It is curious to notice how the child has painted the four legs, quite oblivious of the fact that they are all put at one end of the body, and there is little or no attempt at a head. This shows how useless it is to expect good results from tiny children, for whom it is as much as they can do to hold a paint brush. Nevertheless, the children are absolutely happy in their activity, and are gaining experience in their own small way. Other toys, such as teddy-bears, engines, soldiers, dolls, and so on, are always interesting to young children, and at the same time connect their colour work with their home life.

The loaf of bread and the banana (Plate XXV) are other types of simple objects painted by small children of five years. These were given in connection with a harvest course in the autumn term. The loaf is an expression in connection with the story of the baker. Many other types of objects may easily be found to illustrate a harvest course, such as apples, melons, carrots, and any kind of autumn fruit or vegetable which has simple colours and a simple form.

METHODS OF TAKING THESE LESSONS.—In taking lessons on the representation of an object or toy brought by a child from home, it is necessary to have a short talk about the object, so that the children who are not familiar with it may become interested in it. Sometimes the children may have little competitions to show who can see and tell most about the object. This will encourage them to observe carefully and gain a good concept of the object before they begin to paint it.

If, on the other hand, the children are representing an object about which they have had a lesson, such as a loaf of bread, it will not be necessary to have a long introduction, since the children will have observed and talked about the object during the lesson.

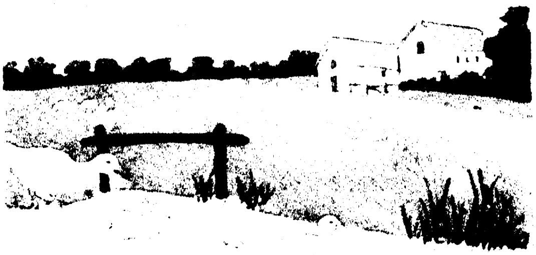
In any case, the object should be put up before the class, so that the children may see it while they are painting. It will be noticed that they rarely look at the object when once they have begun painting, since all small children paint almost entirely from memory. The object should, nevertheless, be there, in case they should wish to look at it again.

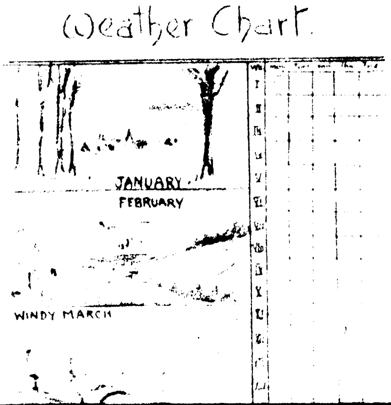
(2) **Practice in Arranging and Combining Colours.**—The kind of work which will be described now is perhaps as valuable in the actual training of *colour* (apart from form), and colour combination and arrangement, as any other kind of work at this very early stage. It may be divided into two groups: (*a*) Co-operative picture making; (*b*) Individual arrangement and colour combination.

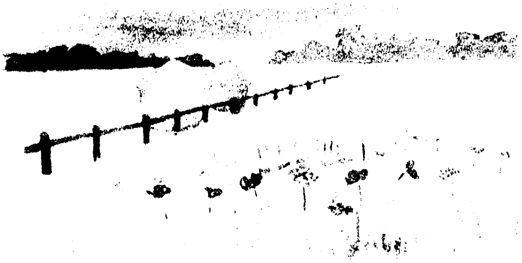
(*a*) *Co-operative Picture Making.*—This consists of the composing of large pictures, nature charts, and other illustrations. It must be remembered that these exercises are for the special training of *colour*, not form, and therefore it does not matter in this case if the children are given objects drawn or cut out ready for them to paint.

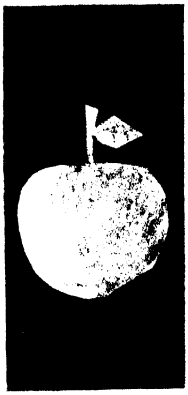
The first picture on Plate XXVI. may be taken as a type of co-operative picture making. This is a picture of a farmyard in spring-time.

First of all it is necessary that the pictures be *large*, say imperial cartridge, 30 x 22 in. A piece of paper this size may form the background of the picture, and on it the teacher draws part of the scene, *i.e.* the horizon, the duck pond, and road. On separate pieces of paper are drawn the farm houses, trees, fence, ducklings,









CO-OPERATIVE WORK AND COLOUR COMBINATION

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duck, sheep, and any other animal the children are interested in and have been learning about. These are then ready for the children to paint. If the children are too young to cut out with scissors, as very often they are, the objects may be previously cut out, so that the children can cover the whole of their object with a flat wash of paint. If there are any children of five years, these may cut out their own paintings. Some children may now paint the ducklings, while others paint trees, fences, etc., and a few others can, in turn, paint the sky, pond, grass, on the big picture. This gives the children practice in good bold flat washes, and children of three and four years will find it quite difficult enough to cover their objects.

When the objects are ready and the background is painted, the children may come out, in turn, and place their objects on the picture to see where they look best, and then paste them on, thus gradually building up the scene. This helps very much in the composition of pictures and arrangement of colours, and, what is also important and valuable, it gives the children the *feeling* of colour, that is, a deeper colour training, though no reference is made to this to the children. It is *influence*, something which will grow to consciousness later on. In the above instance the colouring is mostly blue and green, *cool* colours illustrating the coolness of the water and yet relieved by the little yellow ducklings which give a feeling of brightness, foretelling, as it were, the sunshine of the summer which is to come.

The second picture given is an example of another type of such work. Here the predominating colour is yellow, a sunny warm colour. The objects to be painted and pasted on by the children are the yellow haystacks, brown fence, red poppies and cornstalks, and the hedge. This picture gives the feeling of sun and warmth —quite another atmosphere from that of the last.

Similarly other large illustrations can be worked out. For instance, in the autumn the children may make a large apple tree out of brown paper, and cut out and paste on apples and leaves till their tree is laden with fruit.

Scenes in connection with trades may also be worked out, such as the interior of a carpenter's shop. Here the children may paint the different tools, etc., and paste them on. Or again, a baker with his oven, loaves of bread, etc. In fact, any type of experience lends itself to this kind of co-operative picture making, and is always a great delight to children. It is remarkable also to notice how this kind of work helps the children in their free illustrations. They soon begin to have a much better idea of setting about composing a picture. They have, in any case, gained experience in laying on colour, and in manipulating their materials.

Weather Charts.—Delightful weather charts may be made, which help to give the children the feeling of the colour of the days or months—cold wintry grey days, bright sunny spring weather, windy or cloudy weather, and so on. The pictures for the months are done by the teacher giving the general character of the month, the children chalking in daily, into the squares ruled out for them, the colour they think best suits the day. On the chart shown on Plate XXVI. may be seen little yellow suns showing bright sunny days, blue squares for blue skies, and green squares to represent rain, because the rain helps to make the grass green and the green shoots to come up. Grey represents dull days, and so on. These weather charts should be made large on cartridge-size paper.

Doll's House.—The doll's house is another object in the kindergarten which may be the centre of many kinds of co-operative colour activities. Large, bold, flat washes for wall papers, carpets, linoleums, etc., may be painted and pasted on the walls, floor, etc. Small illustrations for pictures may be hung on the walls, and the children may be encouraged to take an interest in the arrangement of the rooms, so that the colour scheme may be harmonious. All these things, simple though they be, are steps to further development in the child.

(*b*) *Individual Arrangement and Colour Combination.*—Besides the above-mentioned co-operative pictures, smaller individual ones may be made by the children by similar means. Here the children again paint their objects, but have the whole arrangement of the picture in their hands. Individual weather charts and nature records may also be kept, though this is better done when the children are a little older.

The children may also have books in which they paste their own individual work. These may contain examples of colour work connected with their stories and nature lessons, etc., and with children of three or four years consists of painting or chalking objects in outline, to be cut out if possible by the children and pasted into their books. These are again merely *colour* exercises, although incidentally the children learn the shapes of the objects and recognise their form. Examples of this kind of work, representing the coloured leaves in autumn-time and the ripe fruit, are shown on Plate XXVI.

It must be very carefully remembered that this painting in outline must only form *part* of the colour scheme; the children must in all cases be given plenty of scope for free expression, as mentioned in the beginning, since this is a most important factor in the developing of the child's mind.

Mixing of Paints.—When the children are gaining their first experiences in painting, it is necessary for the teacher to mix their paints for them; later on, as will be seen, they should be allowed to mix their own paints.

Work for Children who have had their First Experiences but are still in the Stage of Desire.—When the children are about five years old, a short course on colour work is sometimes very good for them, and will encourage them to observe and become interested in the actual changes that take place when colours are mixed. Such courses should be taken very simply at this stage, and should begin with the six spectrum colours. First should come the three primary colours, red, blue, and yellow. Froebel's Gift I. balls are good objects to begin with, since they are simple in shape. The children may make up little stories about what they are painting to help them to remember what they discover.

For instance, they may imagine that the red, yellow, and blue balls are houses and are occupied by Mr. Red, Mr. Blue, and Mr. Yellow. There is an empty house between Mr. Red and Mr. Yellow, and between Mr. Yellow and Mr. Blue, and likewise between Mr. Blue and Mr. Red. One day Mr. Red and Mr. Yellow decide to go on the same day to the empty house which is between them, and to their astonishment they find somebody is living there after all—Mr. Orange. And so the story goes on, till they have discovered that yellow and blue make green and blue and red make violet.

This course may be continued further by letting the children have experience in blending colours. A good subject for this is a Chinese lantern (Plate XXVI.). The whole shape of the lantern is painted first, in this case with yellow; and then, while still wet, the other colours are put on almost dry, so that as they run in a soft hazy edge is left where the colours meet. The top and bottom are put on in sepia when the rest is dry. The lantern should be painted large.

There are many other ways of gaining experience in colour blending—*e.g.* innumerable sky effects which may be seen in town and country, sunset skies being a particular favourite with children, and rainbows, which show the blending of the spectrum colours in reality. Simple objects such as tomatoes, lemons, green apples, etc., which illustrate the six spectrum colours, may then be given to connect the colours definitely with objects.

Simple Scenes done from Memory or Nature.—To children who have never handled a brush before, the very simplest exercises may be given, such as involve large flat washes. For instance, the child may paint the whole of his paper green to represent a field. Later on, this may be made slightly more advanced by painting the sky as well as the field, and then perhaps a tree or pathway, or whatever the children have seen in the park or country and may suggest. A great wealth of imagination may be thrown into this work. If it is winter, the children will probably paint a snowfield; if summer, grass; if autumn, a cornfield; if spring, a ploughed field, and so on, adapting their picture to their environment and time of year. On Plate XXVI. is an example of this sort of simple scene done by a child of five years, which shows how a small amount of foreground or background adds greatly to the interest of the picture. It is in the doing of these details that the children's individuality plays a great part.

Besides the above, all the other colour activities mentioned in the beginning should be continued—free illustration, painting of objects, toys, etc., in connection with home and environment, practice in arranging and combining colours. Co-operative picture making should also still be continued, better results being expected of the children as they gradually develop.

These are some of the ways in which colour work may be begun. They are based on the principles of self-activity, correlation, connectedness, and upon the truth that the child's first paintings should be the outcome of the *desire to express*, to communicate something. Through these efforts of communication he betters his language, as it were, and strengthens his ideas. The earliest writings were pictures, and so the child tries to express himself through pictures. His love of colour adds special joy to these media which is lacking in pencil work. Having given him the opportunity of satisfying his desire, he soon begins to show signs of inquiry, more marked eagerness to express something accurately. We reach now a very critical stage in the child's development, and signs of it may be seen in various ways.

Dissatisfaction on the child's part with his own work, manifested either by looks or words, shows the teacher that he is entering on the stage of *technical skill.* Children mostly do not know what they want, and therefore it is necessary that the teacher should watch carefully for signs of discontent or inquiry into methods. The love of activity is always present, also the desire to express, but in the first stage it is the pure *desire* to express, whereas in the next stage, to which we are now coming, it is the desire to *know* methods to perfect expression, *i.e.* the desire for technique.

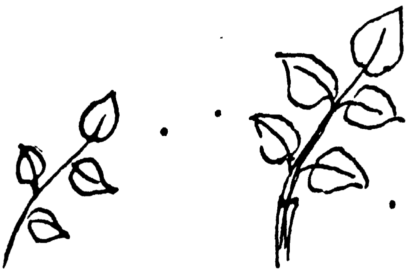
II. **THE STAGE OF TECHNIQUE.**—When a child asks such questions as: How shall I get that green? What colour shall I mix for the flower? How shall I make it look velvety? Why did the flower run into the stalk? Why isn't my painting as good as John's? then we know that he has reached the stage of Technique. He will now be much more critical about his own results, and much more particular concerning the object he is about to paint. Surely it is a sign of advance, both when the child seeks to know ways and means and when he compares his work with that of the rest of the class.

This is the time when the teacher can be of much real and lasting help to the children. Not by answering the children's questions directly, by merely telling them the answers, but by helping them to find their own answers, sometimes by pure reasoning and common sense, at other times by encouraging them to try a different method and suggesting one. But for this the teacher must herself be most careful that she knows what ought to be done, not that she therefore evades the child's question or gives a wrong answer, but that she continues to encourage and guide him to discover until he *finds* what he wants.

A child is likely to lose confidence in his teacher if he feels that she herself is not master of the subject; hence his best efforts will not be made and the work will very often be careless. The following are a few types of painting which introduce simple points of technique.

(i) **Flower Painting.**—Because this has not been dealt with in the first stage, it does not at all follow that flower painting is not to be taken with children in the kindergarten. On the contrary, it may often be taken if the teacher sees that the children are ready for it. It is dealt with here because it is unnecessary to break it up into two groups. As a matter of fact, flower painting is better for the children when they have passed the first stage, chiefly because most flowers are comparatively small and really need more experience in brush manipulation than a very young child is capable of accomplishing. However, all this is left to the teacher, whose methods should depend upon the development of the children. With children of about six, seven, or eight years, in fact from six years onwards, the delight in painting flowers is manifest. It is a popular fallacy to think that children are not interested in flowers. If they are not, this is most probably the result of poor teaching rather than a natural tendency of childhood. It is quite natural for children to like a variety of subjects, and they would no doubt tire of flowers if kept to painting them and never allowed to use colour for other purposes. With careful teaching, much may be learnt in flower painting by young children—*e.g.* (i) the mixing of colours; (ii) careful observations; (iii) appreciation of form; (iv) quality of tone; (v) delicacy of touch; (vi) strength and purity of colour and the love of it.

The secret of success in flower painting is a thorough analysis of the specimen. This needs the careful guidance of the teacher and a thorough preparation of the lesson beforehand. It is almost invariably necessary to study the specimen first in a very definite way, a way which will really help the children to grasp the typical parts and the *growth* of the flower. Results often show that the children have been painting without having been led to notice anything of the character of the plant. A common instance of this may be seen in the painting of a rose leaf; hence such a drawing as Fig. 1 (*a*), showing that the children had not grasped the idea of the leaf-lets growing in pairs—Fig. 1 (*b*). On Plate XXVII. is an example of a child's painting of a spray of mimosa. Here again it may be seen that, although the child had the right idea of the *growth* of the plant in general, yet she did not grasp sufficiently the growth of the flowers and the arrangement of them on the flower stalk. After a thorough analysis of the plant we need to lead the children to make an artistic arrangement of their work. This act of forethought prevents—what is otherwise often the case—the children from placing their flowers just where they see a large, empty space, and consequently strewing their page quite indiscriminately with their paintings.


(*a*) FIG. 1. (*b*)

As a rule, when arranging flowers it is well to observe the following points:—(i) Flowers at the top. (ii) Stalks inclining towards the middle, but not joining, though sometimes crossing. (iii) Balance the whole well on the paper to avoid crowding on one side and blankness on the other. (iv) Work out from the centre, but not too symmetrically, and avoid stiffness.

When children first begin to paint flowers, berries, etc., they cannot be expected to put in shading, for they will have enough to do to mix their colours and obtain the right form, in addition to learning how to manipulate their brushes. They can, nevertheless, show artistic feeling by the arrangement, colours, and growth. On Plate XXVII. is an example of a spray of bryony berries painted without lights and shadows, and of some anemones, showing what might be expected from children at the beginning of the stage of technique. The tulip is a painting by a child of nine years who has had comparatively little practice in painting flowers, and shows an attempt at shading the leaves, though very little in the flower. This child will probably seek to show more difference in tone in her painting of flowers in the future.

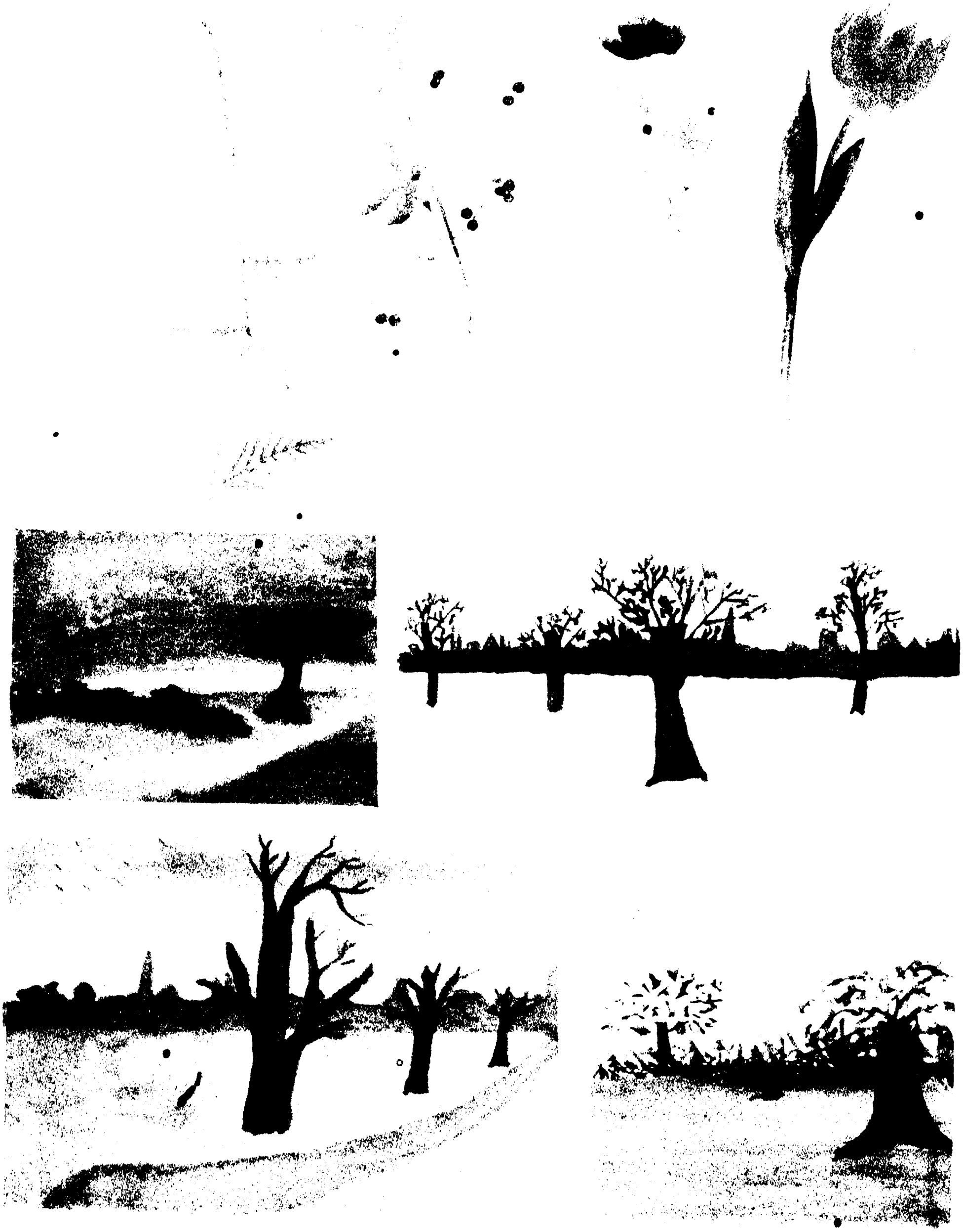
At the end of a lesson it is a very good plan to let the children see the paintings and to say if they think they are good or not, and why; so that they may learn what to guard against and what to aim at in the future. It will be found that the children benefit greatly by considering their own criticisms of their mutual failings and successes.

Besides flowers, the children may paint fruits and vegetables, such as apples, bananas, cherries, carrots, radishes, onions, etc., as these afford excellent opportunity for them to begin shading.

(ii) **Scene Painting.**—As in the first stage, so in this, the children show a great love of scene painting. In the summer time, if the school is in the country or near a park, and the class is not too large, it is ideal to take the children out to sketch from nature—even a garden may give an opportunity. But it is not always possible to take them out, owing to the weather or time of year or time allowed for colour work, and so rather than drop scene painting out of the colour scheme, we must consider the next best way.

The children, whether they live in town or in the country, go out during some part of the day. If they are country children, they will have a constant source of subjects for scene painting. If they are town children, they will find the selection more difficult, but nevertheless by no means impossible if they are trained to go about with the seeing eye. In a large town like London, the most beautiful colouring may be seen in the very midst of houses and streets on a November afternoon at sunset. At least the children could be encouraged to look at the things which happen around them—the beautiful way in which houses and chimneys, which in daylight are very ordinary, appear at dusk to become wonderful romantic buildings silhouetted against a rosy sky.

On Plate XXVII. are shown paintings by two children, aged nine years, who walk daily through Hyde Park on their way home from school and have often seen the sun setting behind the houses. One has depicted it as it looks on a snowy day,



FLOWER AND SCENE PAINTING BY CHILDREN

and the other on just an ordinary November day. There are mistakes in the growth of the trees, but at the end of the lesson the children realised their mistakes and were encouraged to notice the trees particularly as they went home that afternoon. A sunset will always attract those children's attention, and each time they will be able to see more in it and appreciate it the more in consequence.

On the same plate is an example of a scene painted from sheer longing of the child to express what she had seen the evening before. The child, who was eight years old, came with several others (they were children living in the Hampstead Garden Suburb) in the morning, full of the lovely sunset they had seen going home from school, and begged to be allowed to paint it. They were allowed to do so, and the example shown is the result from one of them. They were all done entirely from the children's own remembrance of what they had seen. This is an example of genuine self-expression and spontaneous activity.

The remaining picture is an example of a scene painted by a child of seven years looking from the schoolroom window. The aim of the child was to show how the hedges and trees look in the springtime. Here is an example of correlation with environment and nature study.

It may be noticed from these illustrations that a young child often obtains as good results as, if not better than, a child a year or two older. This proves that there can be no hard-and-fast rule, according to *age*, by which to tell when the stage of technique begins. It is therefore the duty of the teacher to follow carefully the development of the child.

The painting of toys, such as teddy-bears, dolls, engines, and other things brought from home, may also form part of the scheme of colour work. From the foregoing types of colour work—namely, flower painting, fruits, berries, vegetables, etc., scene painting, and toys—experience may be gained of the following technical difficulties:—(*a*) Choosing of colours. (*b*) Mixing of colours in right consistency. (*c*) Blending of colours. (*d*) Manipulation of brush and control of paint. (*e*) Composition and arrangement. (*f*) Delicacy of touch. (*g*) Elementary shading.

These are some of the most important difficulties, and the experiences should help the child through all its future years in the study of water-colour painting.

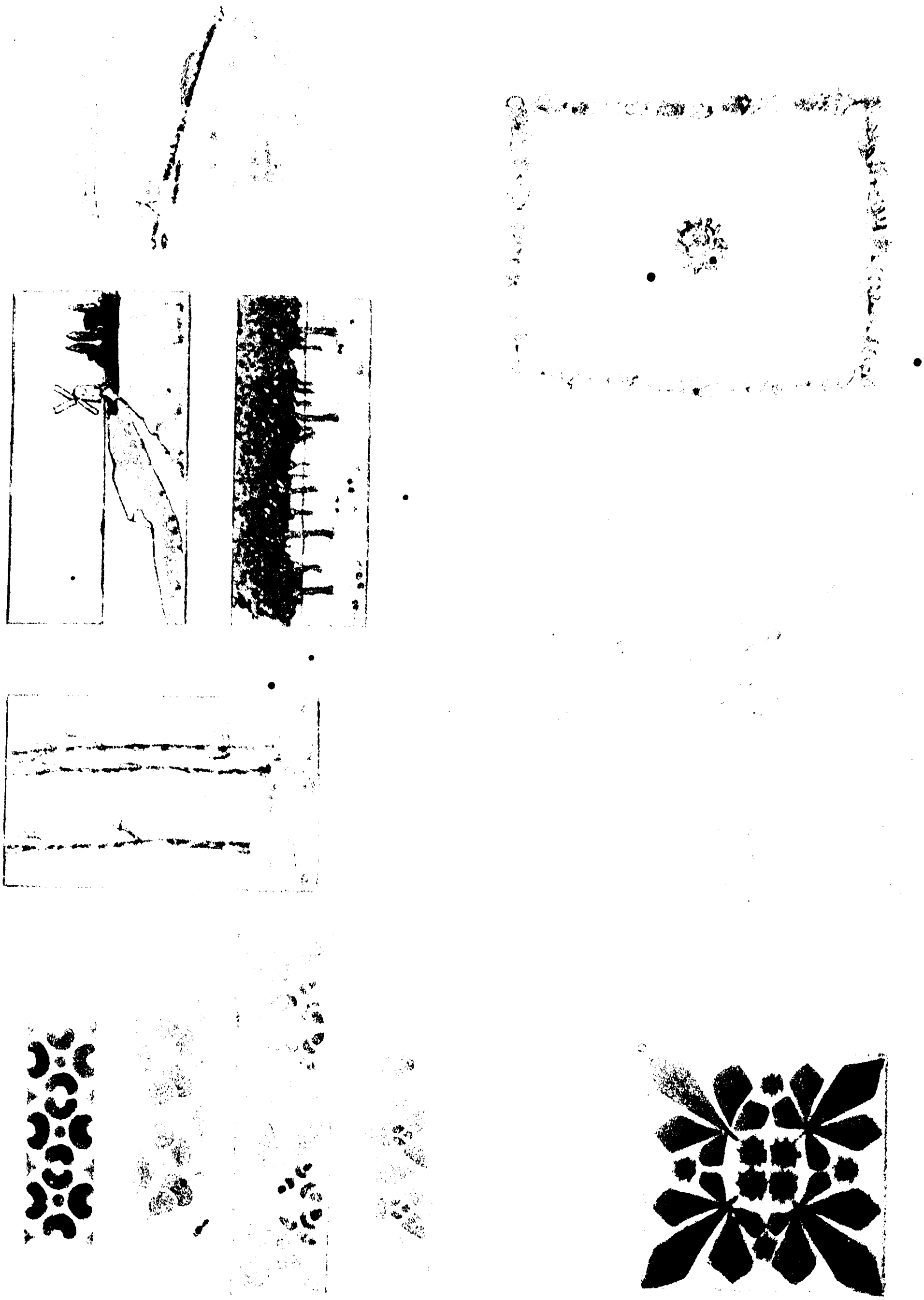
Chalking.—This occupation forms another branch of colour work, which, although not so valuable as painting, yet has its advantages.

It is a very suitable occupation, for these reasons:—(i) Chalk boxes are quickly given out, therefore it is time-saving. (ii) Very little apparatus is needed, therefore it is economical. (iii) The children are less liable to make a mess. (iv) Good colours in chalks may now be obtained. (v) The colours can be mixed on the paper. (vi) The colours do not "run." (vii) The papers can be collected at once and need not be "left to dry." (viii) It need take but little time and can be used for expression work at the end of another lesson.

Some of the most valuable free illustrations may be done with the aid of a box of chalks. Chalking gives the children an opportunity of expressing their ideas through another medium, which is in itself a good exercise; and it may very profitably be connected with nature study. The children may chalk their drawings of birds, animals, twigs, etc., and thus help their nature drawings to become more real to them through the medium of colour. On Plate XXVIII. is an example of a child's free chalking illustrating a harvest hymn. Much thought is shown in this picture—the cornfield with the sheaves of corn cut and ready to be taken away by the cart; the church in the distance where the Harvest Festival is held; and the red sun setting behind the hill which has helped to ripen the corn.

By making a coloured illustration of this scene the child has cleared his own mental image and has acquired skill in composing his thoughts into a picture. One of the first experiences a young child should have with chalks should be on a blackboard, with coloured chalks. Here he can have opportunity of using his whole arm and of making large bold pictures, in the form of free illustrations of stories, scenes, toys, flowers, etc. This kind of chalking may be begun when the child is at the stage of Desire.

There is yet another exercise to which chalking lends itself admirably, namely, pattern making or design. This, however, will be dealt with separately.



S.H.

Design in Connection with Colour Work.—For the past few years designing has been a most important factor of the art training given to both boys and girls at school. This is largely owing to the fact that educators of children have realised that art expression in some degree is the birthright of all, and that pattern making is a very real part of that birthright, which is sleeping in every normal infant, ready to awaken, provided the right call comes at the right moment. When is the right moment? It is when the child begins spontaneously to self-originate, when he begins to decorate his people in his free drawings with zigzag patterns, necklaces, trimmings, feathers to hats, and so on. This tendency shows itself in almost all children sooner or later, and generally quite early. It is then that the child shows that he wishes to satisfy a desire for ornament.

It was the same with primitive man. After he had fashioned his weapons of the chase, he notched them over with various figures; ornamented himself, his pots and utensils with coloured lines, dots, animals, flowers, stars, sun, etc.; and so satisfied his uneducated eye, and desire for colour and order. In the same way a child begins to decorate his drawings; sometimes it is only a flower in each of the four corners of his paper, sometimes he will chalk or paint a border round his picture, often with lines and dots, often with naturalistic (usually plant) motives—this generally by the more developed children. This tendency to pattern making in young children should be carefully developed, even if it is only to help to cultivate the public taste of the future and to prevent the manufacture of the large amount of meaningless, glittering, vulgar ornament which is at present perverting the artistic taste of the people.

Children who visit undesirable picture-palace shows will tend to talk and think about what they have seen there. Similarly the bad designs on wall-papers, cheap materials, useless ornaments, representations of life on some posters and badly illustrated books will tend to perpetuate themselves in their drawings. Fortunately these things are already changing, but there is room for vast improvement. There is only one way out of this confusion, one way which will lead to higher and cleaner standards of taste, and that is deliberately to cultivate the germs of æsthetic taste in children.

The first sign of decoration shown by a child is, of course, very elementary; he will often choose quite abstract or geometric motives, such as lines, dots, or zigzags. Later on he shows more interest in naturalistic motives, leaves and flowers. The making of border patterns is in almost all cases the favourite and most usual way of beginning; it is easier than any other type of designing, and since border patterns are very useful for decorative purposes, it is well to cultivate this first. In the beginning, of course, the children will have no idea of spacing out their designs, but will, if they have an odd space left at the end of a border, fill it up as best they can. In this they resemble all the great early designers and Eastern carpet and rug weavers of to-day.

There are many ways in which children could put their design to practical use, and they should always be taught to do so at this stage. Aimless pattern making is a poor pastime; designing with a purpose has a great educational value, be it for a frieze for a doll's house, a case for the paintings, a blotter, or the like. All designs that the children do when they are beginning are usually done on material that is not permanent, and that will need to be renewed fairly often. This is right, because the children will be continually improving, and will not want to have anything but their best work to adorn their things.

Design affords great scope for colour training, and particularly in colour combination, for the children will have opportunity for choice of colours both for their background, which may often be a tinted paper, and for their design. They will also feel that useful things can be made beautiful, and that simple decoration is often the most pleasing. Here is an opportunity for teaching the children the difference between true ornament and mere decoration, between the aimless strewing of odd motives, sprigs or flowers, without reference to the space they are filling, and true ornament. The way to bring this home to the children is to get them to suggest what they consider to be the most suitable type of design for the particular object they are designing, and gradually lead them to see that by spacing out their ground they enable themselves to distribute their motives evenly, and that the result is therefore more restful and pleasing to look at.

The children at the early stage should not be bothered with such terms as symmetry, harmony, balance, repetition, contrast, variety, and so forth. These the teacher should have in her mind; the children's aim is to make their object look as beautiful as possible, and they will learn that by a certain amount of repetition and care in arrangement a good result can be obtained.

Concerning the choice of colours, the children should be allowed to choose their own colours entirely; often their choice will be far from what the teacher would have chosen, but it is necessary for the children to go through many stages in order that in the end they may have that confidence and boldness which characterises all good original work.

With quite little children it is often a very good plan to give them something concrete to design with. For instance, quite good simple designs may be made with coloured beads. Later, sticks may be introduced to form a variety. The designs may afterwards be chalked on something which the children wish to decorate. From mere repetition the teacher should gradually lead them to see that variety and contrast relieve the monotony of a design and make it more interesting.

An example of the way in which designing with lines and dots may be developed is shown on Plate XXVIII. As the child gets more experience, it will be noticed that he takes more interest in plants and his designs will become more naturalistic. It is at this stage, when the child is about seven or eight, that more definite teaching in design should begin. Many things may be learnt gradually, if presented to the children at the right time. On the same plate is a design done by a child of eight years. It is entirely original, and the choice of motive, namely, a rose, was her own. The child's aim was to make a pattern for a brown-paper case to keep her paintings in. This child has reached the stage when she realises that contrast both in form and colour make a design more interesting. A child at this stage is ready for simple exercises with a paint brush, whereby she may learn much about colour and form and the more regular spacing out and planning of designs.

On Plate XXVIII. are shown several types of space-filling exercises, using more naturalistic motives. The 1st (top left corner) represents the type of pattern a child might evolve if given kidney beans to make patterns with. The pattern is first made actually with the beans and then worked out in colour. The 2nd and 3rd are simple motives based on the acorn and snowdrop, and worked out in more detail in the 4th and 5th. The 6th is an elementary space-filling exercise with the horse chestnut as motif.

Children may learn much about colour in doing simple exercises such as these: *e.g.* (*a*) Colours that go well together. (*b*) Colours that form a good contrast. (*c*) Where to use bright colours. (*d*) When to use colours of the same tone, but in more than one intensity. (*e*) What kind of colour to use for a background to show up the design. (*f*) How many colours to use—for children generally not more than two. There may be two shades of one colour and one other. (*g*) On the distribution of colour in a design—avoid scattering the colour and keep large masses the same. (*h*) Colouring may be conventional and not necessarily natural, to allow the design to be adaptable to the purpose for which it was designed.

Some delightful co-operative designing may be done by quite small children, such as friezes for the kindergarten room. For this the children paint, for example, trees or boats or whatever is going to form part of the design, cut them out and paste them at equal distances on brown paper. These may be made very effective. The small drawing Fig. 2 is a type of what might be done co-operatively.

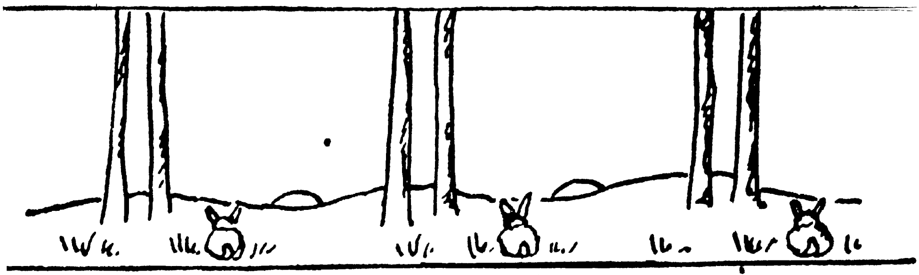


Fig 2.

Ways of Teaching Colour other than the Above.—In the kindergarten there are always many opportunities of teaching colour work incidentally. The following are examples.

I. *Colour Games.*—These include guessing games, in which one child is elected to choose a colour of any object in the room. For instance, the child says " I see something red," and the other children have to try to guess what it is. They are obliged to open their eyes and look for all the red things in the room, till the right one is guessed. The winner then chooses some other object, and so the game goes on.

There are also matching games, where the children name all the objects of the same colour in the room and see who can find the most. These are simple games, but they can teach much to a child just beginning to learn to discriminate one colour from another, and they can also give the teacher a clue as to what are the most popular colours with young children. She will probably find that the youngest love chiefly the bright oranges and yellows and reds, while the older ones take more notice of the colder colours, greens and blues. These things should all help the teacher in the selection of objects for the children to paint.

II. *Opportunities of Choice of Colours.*—Children should be allowed to have the opportunity of choosing colours, especially with regard to their suitability for the object for which the colour is meant. For instance, when sewing, the children should be encouraged to choose their coloured silks. In weaving with raffia, also, they may learn to combine two or more colours that go well together. In the arrangement of their doll's house they can be trained to put suitable colours together, in order that the rooms may be harmoniously coloured. Again, in their own class-room the children should learn how to arrange their flowers, and the teacher may help in the decorating of the class-room by putting up good coloured pictures and illustrations. All these things lead the children to apply their knowledge of colour to something definite, and to realise the suitability of certain colours at certain times, and that " All is fair that's fit."

The teacher must not be distressed, however, if the children's taste is crude, since they cannot be expected at this age to have anything like a developed taste. This does not matter; indeed, it would be foolish to expect anything else, and the teacher must be patient, and not impose her taste upon the children and try to have them see with her eyes. She can train them by example, by her own illustrations, which should be numerous—including suitable seasonable time tables, nature charts, illustrations—and pictures, which the children, if their attention is properly directed, will learn to understand, know, and love. In this way the children, without being forced, will grow to like what is suitable and beautiful; will learn to love bright colours, in their places, as well as soft tones; and will learn to realise that *all* colours are beautiful when they are the attributes of the object to which they rightfully belong.

Materials.—A word or two about the kind of materials which have been found useful in schools may be helpful to some.

(*a*) *Paints.*—In the first stage, when the child is quite young and inexperienced, it is absolutely necessary for the teacher to mix the children's paints for them. But as soon as the children reach the stage of technique they should be allowed to have their own paint boxes if possible. This does not mean elaborate tin boxes with about two dozen colours, many of which are useless, and two or three worse than useless brushes. It means a small cardboard box with about half a dozen tubes of paint.

The most useful colours are: blue, cobalt or ultramarine (either of these two), gamboge or a middle chrome yellow, crimson and scarlet lake, burnt sienna, and sepia. These colours are quite good enough for ordinary school use, and may be obtained from various makers. From these colours the children may mix their own orange, green, and purple. It may be useful, however, for the teacher to have one or two more colours, such as black, white, and purple, for in the less expensive colours it is difficult to get a vivid mauve—in which case the teacher might supply the mauve herself if she does not wish the children to have too many colours in their boxes; but as a general rule the colours given above will be amply sufficient for all shades and tones of colours.

(*b*) *Brushes.*—Although a child is perfectly satisfied with whatever brush the teacher gives him, since he has implicit faith in the teacher, yet the teacher must not on this account think that any brush will do. Any brush will not do, and it is only fair to the child to give him suitable materials from the beginning. Many schools provide paint brushes which are not fit for anybody to use, much less a child who is inexperienced. The brushes spoken of here are those small, cheap, very badly cut ones. In the end they are not cheap, for, firstly, they need renewing often, and secondly, it is wasting the children's time to try to teach them to paint with tools which will give them quite the wrong touch and technique, which they will have to unlearn later on.

The best brushes to use for children are *large* brushes, but brushes which nevertheless make a good point. The best way to test them is to dip them in water and shake them out. If the point is good, then it is the brush you want. Such brushes are not expensive and last a very long time. Children have been known to have them several years. No. 8 finest camel-hair brushes are very good, price 4*d.* each, such as supplied by Reeves & Son. The smaller numbers, as 7 and 6, are good, but No. 8 enables children to paint large bold washes as well as small delicate things such as stalks, flowers, etc. The painting of these is largely a matter of brush manipulation, which, if properly understood, simplifies painting to an enormous extent.

(*c*) *Palettes.*—A most useful kind of palette is the four-division saucer. These may be had in very inexpensive forms. They should be deep enough to hold a good deal of paint, and should take up comparatively little room in a cupboard.

(*d*) *Paper.*—It is advisable to have separate sheets of paper, instead of a book, for these reasons:—(i) Paper is less cumbersome on a desk than a book. (ii) The children are encouraged by having a clean piece of paper at the beginning of a lesson, rather than a book which almost invariably becomes untidy, especially when it is nearly full. (iii) Paper may be easily collected and given out, and takes up less room than books. (iv) The children may be encouraged to make and design cases for their finished works. These may be taken home at the end of the term and new ones made, thus giving them an opportunity of designing with a purpose.

(*e*) *Paint rags* or old pieces of blotting paper are necessary for the wiping of brushes during the lesson. Blotting paper is useful and practical because it can be burnt at the end of the lesson, thus helping to dispose of otherwise useless blotting paper.

Technical Difficulties.—There are many teachers who would give very good lessons, and would find a great delight in the giving of them, if they had a little more first-hand experience with colours themselves. As the child learns by experience, so does the adult, and if many teachers would take a box of paints and would paint little things often and often, things they intend to give the children, they would soon know where the difficulties lay, and would find the children making great strides and being doubly interested in the colour work lessons.

It is absolutely necessary that the teacher should know as much about her subject as she can, no matter how young and undeveloped the children are.

Suppose, for example, the teacher intended to give the children a yellow marguerite to paint, and she had not happened to have painted one herself before, the results from most of her children, at any rate with the first flower, would be something like Fig. 3. Whereas if she herself had practised painting this flower, she would have discovered that the easiest way for a child to paint it is to paint first the middle and then four of the petals which they see, in the form of a cross (Fig. 4). It is easy then to fill in the others.

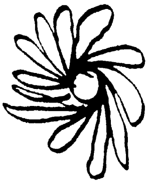


Fig. 3.

It does not matter, however, if the children do it like Fig. 3 at first—they will then learn by experience; but the teacher will immediately have a remedy in her mind, which she should elicit from the children. This is only one small example. There are others which may come under the heading of "Teacher's Forethought." The following are examples:

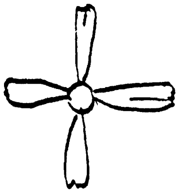


Fig. 4.

(i) *Mixing of Paints.*—It has already been said that the teacher must mix the children's paints when they are quite young, and since the result of the painting and the possibility of expression depend largely upon the right consistency of the pigments, it is absolutely necessary that the teacher must realise beforehand how to mix the children's paint.

Too often one sees saucers full of watery paint for children to paint flowers and other such things. It is impossible to expect the child to express his ideas truly when he is given absolutely unsuitable material with which to do it. The greatest artist could not paint flowers with a saucer full of watery paint, much less a child. No wonder the results are so often anæmic and untidy and the children disappointed. Moreover, if the children are used to being given watery paint, they will naturally begin mixing their own paints in the same way when they are given their own boxes.

There is, however, one time when the children's paint needs to be watery, that is for painting flat washes. Here enough paint should be mixed to allow the child to paint the *whole* wash if the result is to be a good one, *i.e.* perfectly clear, without streaks and lines where the paint has dried while fresh has had to be mixed. The paint must be watery in this case, or it will not "run" as it should. One of the best and easiest ways to paint a flat wash is to have the paper slightly slanting. Begin in the left-hand top corner with a brush full of paint. Take it right across the paper, leaving a line of drops. Then take more paint, and just below the first layer put another one, so that the drops run in. Continue in the same way till the wash is complete, taking the drops at the end into one corner and sponge them up with the brush. Backgrounds of designs should be done in the same way.

(ii) *How to Manage a Paint Box.*—When the children have their own paint boxes they will, of course, mix their own paints, and it is most important that from the very beginning they should be taught how to use their paints, even if this takes up a good part of the lesson.

There are many things for a child to learn when he first becomes the possessor of all his painting materials, and the teacher must think of these things *before* the lesson. It may be helpful to remind ourselves of a few of the most necessary.

(*a*) *How to manipulate tubes of paint.*—They must *always* be squeezed from the *bottom*. The reason for this is quite clear, and can be found out by the children. If squeezed at the top, the paint is pushed down and consequently oozes out at the bottom.

(*b*) *Where to place the paint on the palette.*—The paint should be placed at the corners round the edge of the saucer, so that there may be plenty of room for mixing paint in the middle (Fig. 5).

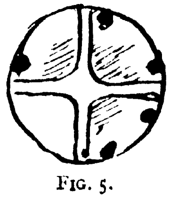


FIG. 5.

There are many other points which the children will learn as their experience widens, such as: how much water to mix with their paints; when to leave it dry; and when wet. How much to take in their brush, so that they may have control over it. When to use the tip of the brush (for fine stalks, etc.), and when the whole brush. Always to remember to wash their brushes well before taking a new colour, and to take out all the paint possible by putting them against the edge of their saucers before washing them, so as to avoid wasting paint and making their water unnecessarily dirty. All these things are most important when the child is at the beginning of the stage of technique, and must be really carefully thought out by the teacher and presented to the children from the beginning.

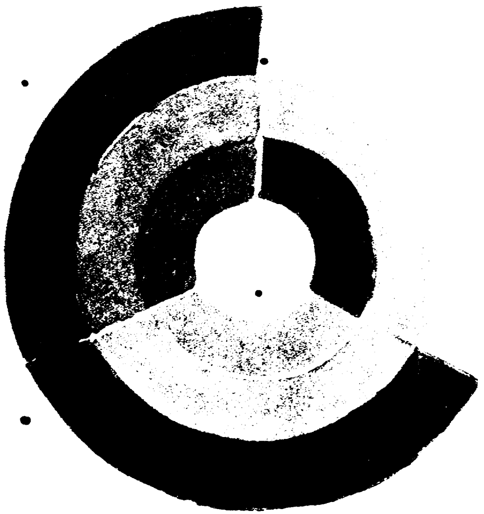
It is an excellent plan sometimes, especially with a large class where the teacher cannot possibly give quite so much individual attention, to have what may be called "drill" before the children begin to paint. This means questions by the teacher and quick answers from the children concerning their materials. "How should the paint be squeezed out?" "Where should it be placed on the palette?" and certain other questions concerning the consistency of the paint, etc., which the teacher feels will help the children to paint well whatever she has prepared for them. This need not make the lesson at all stiff or formal, but should arouse keenness and make the children alert. It will also train them in habits of forethought, which is one of the most valuable habits, and is particularly trained by water-colour painting.

If by any chance it is really impossible for each child to have a small paint box, the next best thing is for the teacher to squeeze the paint on to the palette round the edge as before explained, so that the children may at least *mix* their own colours.

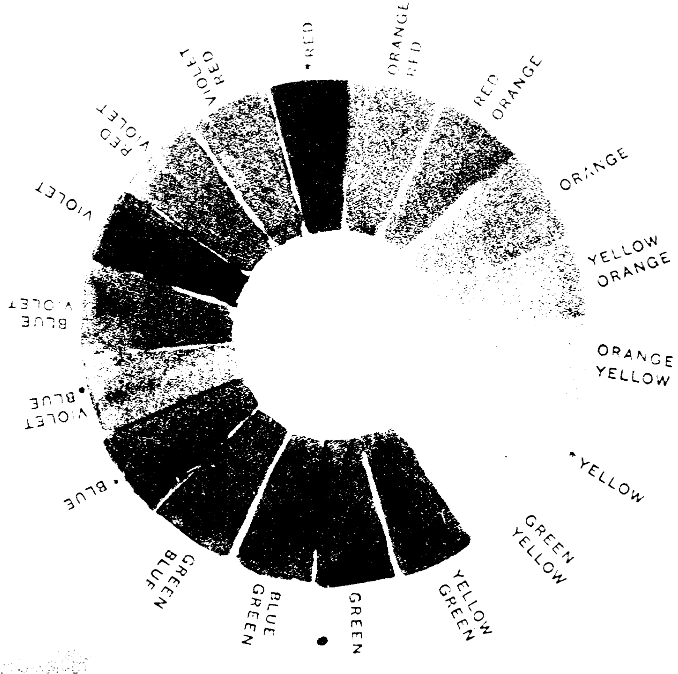
Teacher's Illustrations.—In making illustrations for children in the kindergarten the teacher must remember that small children are incapable of understanding a very elaborate picture. It is better, especially if the teacher finds illustration difficult, to keep to very simple types, and to make a point of having the drawing and colouring, of what is there, good. It may be helpful to some to know how to set about making a simple illustration. First of all, it is often impossible to bring into the illustration *everything* which was mentioned in the story or nature lesson, or whatever

PLATE XXIX

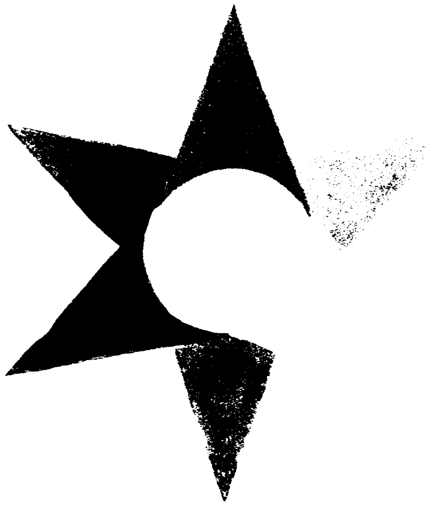
COMPLEMENTARY COLOURS AND THEIR GREYS



HUES OF COLOURS



* = THE THREE PRIMARIES



SIX SPECTRUM COLOURS

the teacher is illustrating, therefore she must think first and decide what is the most important thing to illustrate. Having settled this in her own mind, she needs to think of one or two more points before putting her ideas on paper—*e.g.* (i) Where shall I place the horizon? (ii) What shall form the background? (iii) What the foreground? (iv) Which shall be the lightest spot? (v) Which shall be the darkest spot? (vi) Where is the light coming from?

As regards colour, the teacher must, above all, keep it clean and clear. Avoid black, greys, and browns for *shadows.* Mix the complementary colour in order to get shadows or a darker tone of the same colour. Black may be used for outlining if the illustration is done in flat wash. This is a very effective way of doing illustration and suitable for young children. The three landscapes on Plate XXVIII. are examples of pictures painted in flat wash and outlined: (*a*) illustrates the story of the Mill, which is told to the children in the autumn term in connection with the Harvest Course. (*b*) illustrates the orchard, with the apples ready to be gathered in for the harvest. (*c*).—This is a picture such as may be used on a nature chart for February. Very interesting nature charts may be made for each month, with a part cut off for a picture illustrating the character of the month and the rest ruled out for the children's news and observations. The children are always keenly interested to see what the new picture for the month will be. These illustrations are for use in a kindergarten, and are therefore very simple.

Colour Charts.—Plate XXIX. (i), (ii), and (iii), are three colour charts which may be helpful to those who do not realise the way in which colours are obtained.

The first one shows the six spectrum colours, the colours of the rainbow—namely, the three primary colours, red, blue, and yellow, and in between, the colours which are derived from mixing two of the primary colours together. The second chart shows again the six spectrum colours and in between colours that are *hues* of the spectrum colours. They are arranged as follows: *Red,* orange red, red orange; *orange,* yellow orange, orange yellow; *yellow,* green yellow, yellow green; *green,* blue green, green blue; *blue,* violet blue, blue violet; *violet,* red violet, violet red. If these colours are mixed with more water, they become *tints*; i mixed with black, they become *shades*. There can be severa shades or tints of all these colours, according to the amount of water or black mixed with them.

Chart (iii) represents the six spectrum colours with their greys. That is, red and green mixed give grey, blue and orange give grey, and mauve and yellow, grey. These colours, which when mixed together give grey, are called complementary colours. They are the colours which should help in giving warm shadows in painting, instead of blacks and browns. By mixing any of the pure colours in the charts with grey, colours in half intensities may be obtained. These are the soft-greyed tones which may be used in designing later, when the children have had more experience with colour.

BOOKS FOR REFERENCE

E. G. Yeats: *Elementary Brushwork Studies* (George Philip & Son). J. W. Nicol: *Brush Drawing: a Handbook for Teachers and Students* (Blackie). May Mallam: *Brush Drawing as applied to Natural Forms and Common Objects* (George Philip & Son). A. H. Church M.A.: *Colour: an Elementary Manual for Students* (Cassell).

XLVII. SPECIAL WOODWORK AND METALWORK FOR RURAL SCHOOLS

By GEORGE F. JOHNSON

Inspector of Schools (Handwork), Liverpool Education Authority; Editor of "Educational Handwork"; Author of "Rural Handicrafts," etc.

Assumptions.—It is assumed throughout this article that some skill in the manipulation of tools has been acquired. The work is suited to boys of the age of eleven and onwards. It is not actually necessary for those setting out on such work to have had a definite training in manipulative skill, but such training will be an obvious advantage. A boy who has been educated on handwork lines in his earlier years—in paper, cardboard, strip or light woodwork—will naturally have an advantage, from the point of view of skill, over one who has received no such training.

The Models.—The models are intended to be made so far as is possible the full size so that the work may have the element of reality to the boys. Some of course are impossible in a school workshop; but where this is so, it is suggested that the work be carried out just as it would be in a full-size model, that is, the processes employed in fastening, etc., should be identical, though the models be made in a workable size suited to the exigencies of the workroom. This will serve as a fitting preparation to the construction of the same or similar models when the boy is faced with the real problems of life in the home, on the farm, or life in the country.

Though primarily intended for rural schools, the models are not unsuited to town schools. In fact, it is not an uncommon experience to find in the latter schools boys who have a real desire to make such models, and where this is the case it is advisable to encourage the desire, for by such means acquaintance with the life of country dwellers is made more actual.

Sufficient details are given for the work outlined in the following pages to be executed by those with the preliminary training mentioned above. Much is left unsaid in order to give each one undertaking the work an opportunity of deciding some of the points himself. It is the intention of the writer that the models should only be regarded in the light of examples of "possibilities." A thousand and one other objects will suggest themselves afterwards to those who desire to pursue the subject further.

The work has been divided into three sections, but many other objects may be made, which include a combination of the materials mentioned in the several sections.

WOODWORK

Potato Smasher (Fig. 1).—In smashing up food for sheep and pigs a potato smasher is frequently required. A stout piece of wood for the head should be obtained, and a hole bored in the centre, while the bottom of the inside should be made a little wider to allow of the "spreading" of the end of the handle (which may be a part of an old broom stick) when the handle is driven in with a wedge. Make a saw-cut in the end to be fixed into the head, and lightly insert a wedge. When the handle is driven into the head, the wedge drives up into the saw-cut, and prevents the handle from coming out in use.

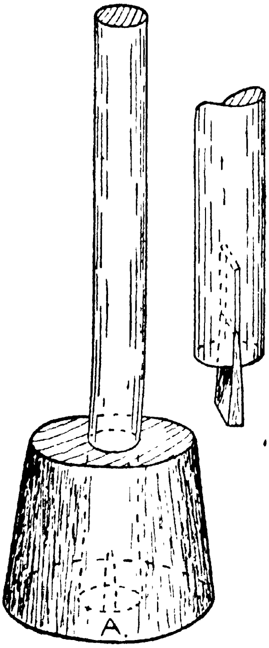


FIG. 1

Garden Tool Rack (Fig. 2).—Unless it be hung up above the floor, it is somewhat unpleasant—not to say dangerous—to tread unwittingly on a rake or hoe, and suddenly receive a blow from the handle. To avoid this, a rack may be easily fixed on the wall of the toolhouse to take all the usual tools. A piece of wood about 3 in. wide and 1 in. thick is all that is necessary. Space out the places for the various tools—rake, spade, hoe, fork, etc., and cut out at suitable intervals pieces of the wood suitable for the handles of the respective tools to rest in. The length of the rack will depend on the number of tools and the wall accommodation. Two or three holdfasts should be driven into the wall to support the rack, or pieces of wood nailed to the wall on which the ends of the rack may rest.

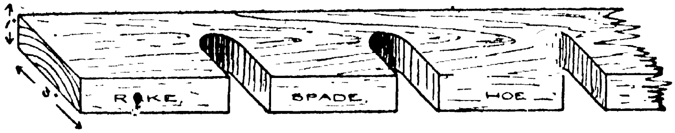


FIG. 2

Bucket Rest (Fig. 3).—Instead of the usual hoop used by farm hands for carrying two buckets containing water or other liquid, a framework, simple but effective, similar to the one shown in the sketch may be contrived. It has the advantage that it can easily be put away when not in use, and it occupies little space. Prepare two pieces of wood say 3 ft. long and 1½ in. × 1 in. Near the ends of each piece bore a hole large enough for a stout rope to pass through. Cut two pieces about a yard long, and knot one end of each; pass each through the holes made and knot the other ends to form the frame shown. Walking within this frame (with a bucket outside each rope end), carrying pails of water, etc., is much easier mechanically than allowing them to bump against the legs.

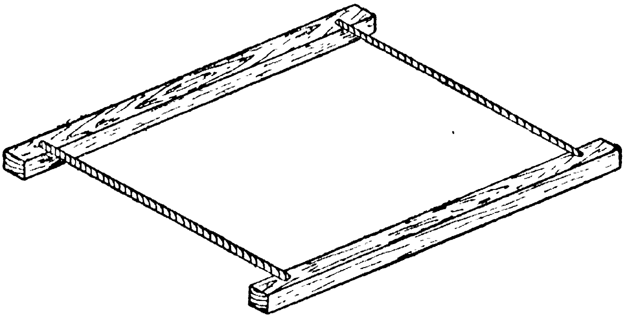


FIG. 3

Boiler Rack (Fig. 4).—When things are boiled in large quantities it is sometimes necessary to take them out of the boiler to see if they are "done." In order to do this more conveniently a rack is frequently provided to fit along the back of the boiler, such as is shown in Fig. 4. The bars act as a sort of strainer while the two rails are made to fit obliquely round the circle of the boiler top. It is necessary in the case of linen and other delicate fabrics to have the screws or nails, by which the bars are fastened to the rails, of copper or galvanised iron in order to avoid ironmoulding the linen, etc., which would follow the use of ordinary nails or screws.

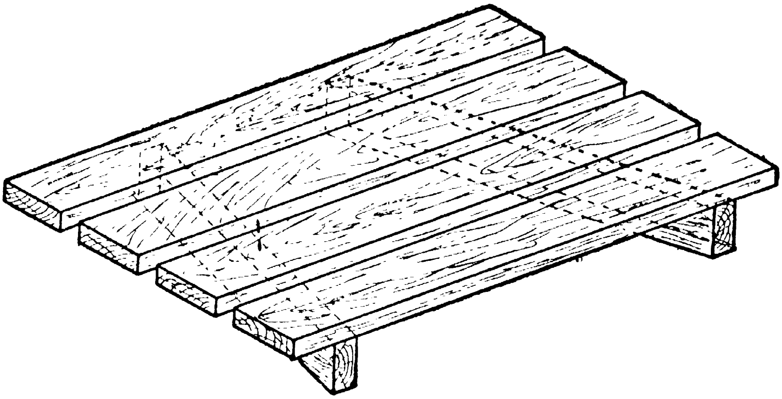


Fig. 4

The sketch explains the construction and the sizes will vary according to particular needs.

Root Tray (Fig. 5).—It not infrequently happens when planting-out time comes that roots and young plants have to be carried from the cold frame to the bed or border. In order not to crush or injure the plants, they may be carried in some such vessel as that shown in the accompanying sketch. This is a framework about 16 in. × 12 in. × 5 in. made of wood, the sides ½ in. thick, and the ends ¾ in. thick. Other sizes may be desired, and the material should be of corresponding thickness. As there is no solid bottom to this framework, the whole will be made more rigid if the corners are bound with pieces of tin. This may be obtained from a disused coffee-tin, or other similar article cut to the necessary size.

Four pieces will be required about 4 in. × 5 in., and bent in the form required to fit the corner as shown at A in the figure. These pieces of tin should be nailed with small tacks, so that the latter do not come through on the inside of the tray. A piece of fine wire netting should be stretched and nailed on the bottom of the frame; and with the addition of a shaped piece of wood at each end to serve as a handle, the thing is complete. It would also serve as a riddle or sieve for light coarse soil. The frame might also be made from a good strong box from which the bottom has been removed.

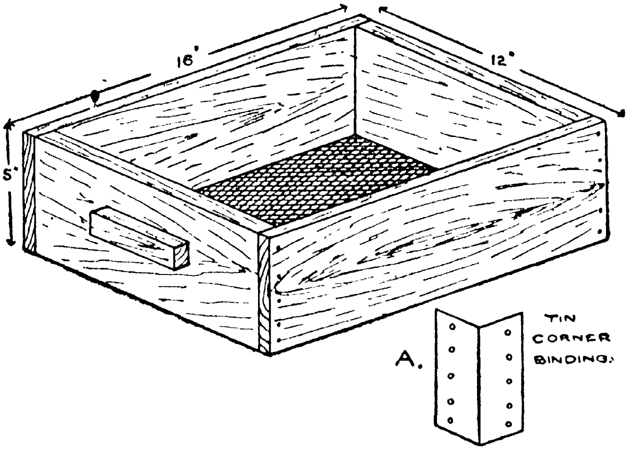


FIG. 5

Hand Frame (Fig. 6).—This may be conveniently constructed

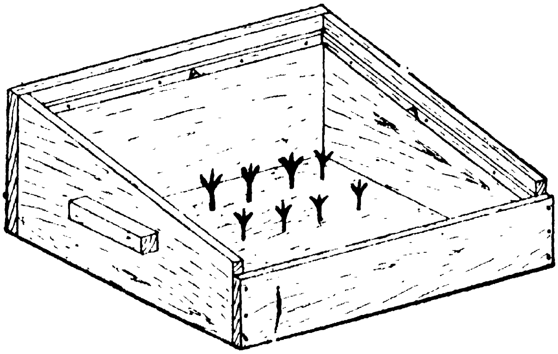


FIG. 6

from quite an ordinary box, or four sides may be nailed together to form the four sides according to the size required. Having decided on this, nail round the inside edge about ¾ in. from the top a narrow wooden rail or bead (see A in Fig. 6) about ¼ in. thick and ½ in. wide. Next cut out a piece or pieces of glass to fit on the top of the rails. In order to keep the glass in position, nail a second rail on the inside of the top edge above the piece or pieces of glass. On the ends of the frame nail suitable pieces of wood to serve as handles, so that the frame may be carried easily from place to place. A slope may be given to the glass, as indicated in the figure, in order to get more sunshine, or the box may be left the same depth all round.

Riddle Rails (Fig. 7).—In order to facilitate the riddling of ashes—the dust of which is often used to "lighten" heavy soil, and the cinders for "backing" a fire—a rack composed of two rails and held apart by two struts may be usefully employed. The bin or box or midden into which the dust falls will determine the length of the rails, and the width of the riddle the length of the struts. These latter may be simply nailed to the former by good long nails, but a better result will be obtained by mortising the struts into the rails as shown at Fig. 7, A. This will render the frame more rigid and hence more serviceable.

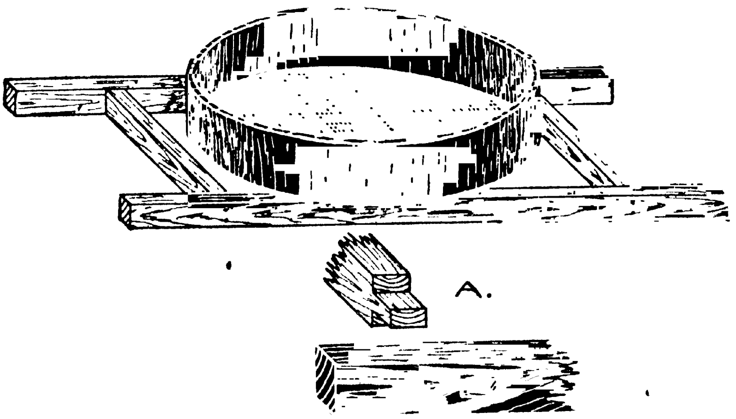


FIG. 7

Brewer's Paddle (Fig. 8).—When home brewing is undertaken, a paddle for mashing the brew is a useful article of the household. For this obtain a handle about 5 ft. long and 1¼ in. thick. Shape the handle end round with plane and scrape with rasp or a piece of broken glass, and smooth with glass paper. Use four pieces of ⅜ in. dowel rod for the rails, or if these are not available, round off a piece of wood 3 ft. long and ⅜ in. diameter. At equal distances in the square end of the shaft bore four holes ⅜ in. in diameter, and corresponding holes in the side pieces A and B. Drive the four rounded rails through the holes of the shaft, and make a saw-cut in the end of each rail ready for a hardwood wedge. Fix the side pieces A and B on to the rails and drive in the wedges, taking care that the latter are at right angles to the length of the sides (or across the fibres of the wood) in order to avoid splitting. Plane off the rough ends of the wedges on the outside, and drive a small nail through the shaft and each rail.

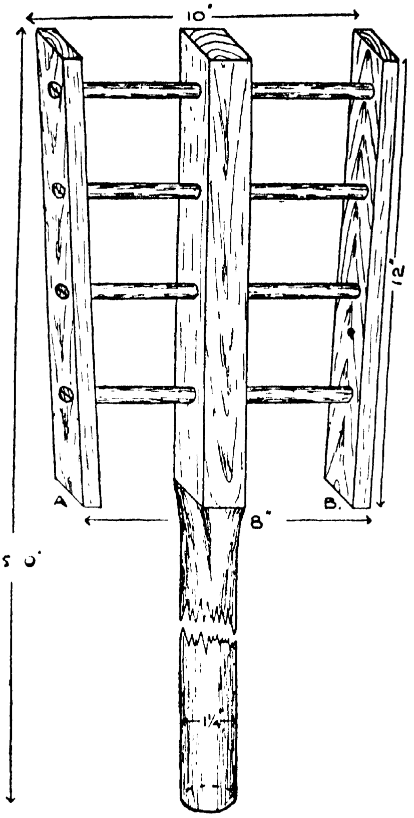
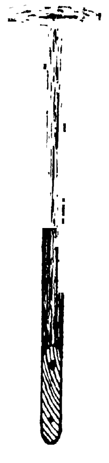


Fig. 8



Potato Spade (Fig. 9).—Obtain a piece of strong wood—preferably beech or oak—and shape it much the same as the blade of a spade, only larger (see 9, A). The top end which is to

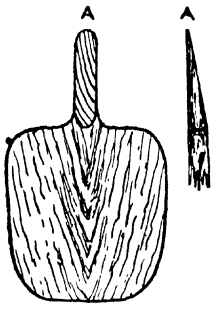


Fig. 9

be attached to the handle should be tapered off as shown in the drawing A, A. The bottom end of the handle should be tapered in the opposite direction, so that when placed together they fit and form a round continuous handle. Glue these two faces together temporarily, and through the joint bore two holes to take two quarter-inch bolts and nuts. Screw the nuts up tightly, and bind round the whole length of joint with copper or galvanised wire, driving the end of the latter into the wood of the handle to prevent it unwinding.

As this spade is only used for lifting and rolling the potatoes from a cart, or "shovelling," it is unnecessary to have an article finished to the same pitch of excellence as one used for much heavier work, such as digging heavy sods.

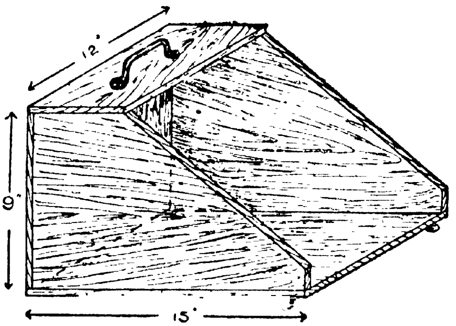


Fig. 10

Coal Trug (Fig. 10).—The accompanying drawing shows a very useful form of coal scuttle, and one very simply made. Cut out two pieces of wood (about ¾ in. thick) for the sides as indicated in the figure. Screw on a piece the same thickness 15 in. long and 12 in. wide for the bottom, and nail on a piece 9 in. × 12 in. for the back. Cut a piece 12 in. × 6 in. for the top, and screw this in position. On the top of this piece, screw a handle of brass or bronze. Two feet screwed on to the front end of the bottom will tend to keep the coal from falling forward, and out of the box. The feet may be made from small cotton bobbins or one large one cut into two. Give the whole trug a coat of stain, and varnish on the outside. The shape and sizes may be varied to suit circumstances, while an ordinary box cut down to the shape shown will also serve the same purpose.

Egg Box (Fig. 11).—A difficulty frequently experienced by farmers and others who keep a large number of fowls is to know how to store the eggs conveniently. There is a practical way of overcoming the difficulty. Either make or obtain a suitable box for the purpose; the size will depend on the needs of the case. Nail strips of wood across the inside of the ends, as shown in the diagram, sufficiently wide apart to allow the eggs to rest in the holes of the trays without being broken by contact one with another. For the trays obtain several pieces of wood about ¼ in. thick—one piece for a tray—according to the size and number the box will take, and bore suitable holes for the eggs. Arrange the front of the box so that it will open on hinges, and when closed in position fix a small hook and screw-eye for fastening it securely. The hook and eye may be made from ordinary wire if the former are not easily accessible. In order to facilitate carrying, screw on each end a handle or a strip of wood to serve as such.

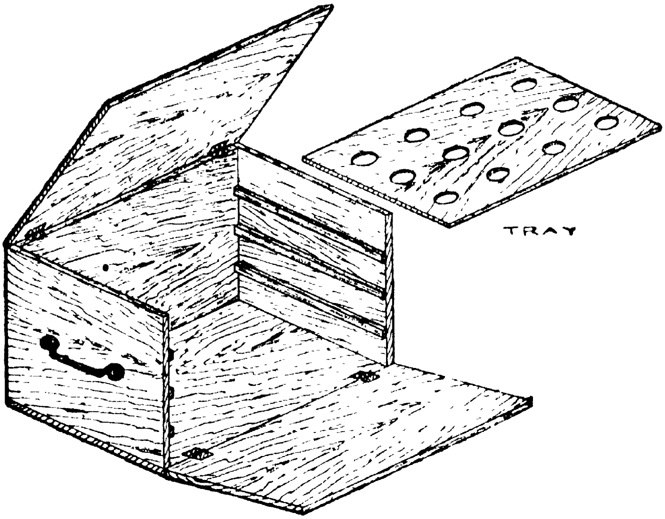


Fig. 11

Plant Carrier, or Hand Barrow (Fig. 12).—In a large garden this is absolutely necessary, and in order to make it, obtain a length of about 12 ft. or 14 ft. of wood, 1¼ in. square. From this cut off two pieces for the sides about 4 ft. 6 in. long, and two shorter pieces about 2 ft. long for the cross rails. These should be tenoned (as shown at A, Fig. 12) into the sides at such a distance from the ends as to allow for the shaping of a suitable handle on the projecting pieces. The mortices in the sides should then be made, and the four pieces driven together. Bore a hole ¼ in. in diameter through the sides and tenons of the rails (B, Fig. 12), and drive a wooden dowel into each of these. The frame, with the exception of the shaping of the handles, is now complete. A good form of handle is shown at C in the figure, but a simple rounding off of the ends will suffice for all practical purposes. A box has now to be constructed in order to rest on the framework. This box may be of several kinds, according to purpose. In the first place it may be quite detachable from the framework; or it may be made without a bottom, and the framework covered permanently with pieces of wood to act as a floor; or it may be made with only one removable side. In any case the framework should be strengthened by fastening in each corner a triangular block as shown in the figure.

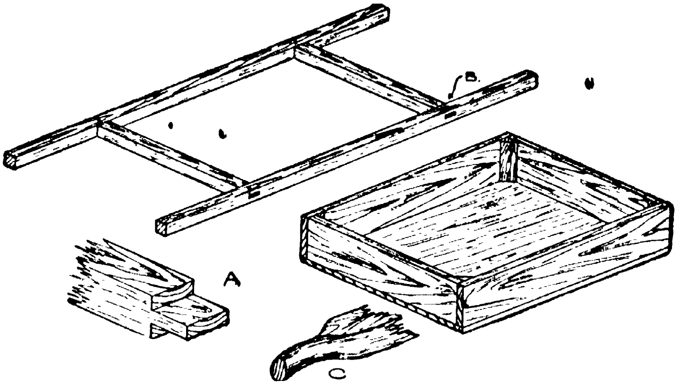


FIG. 12

Grain Scoop (Fig. 13).—A scoop similar to the one shown in the sketch is very easily made from part of a grocer's cheese tub. Cut out a piece of sound wood about 1 in. thick for the back end, make a handle from part of a broomstick, and insert the end of this in a hole bored in the back. Wedge this from the inside at right angles to the fibres of the wood. Take a piece of cheese tub of suitable size, and carefully steam and bend to the shape of the end

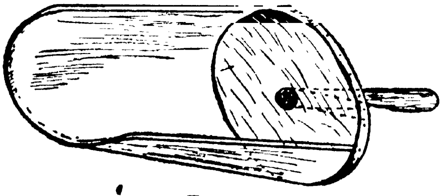


FIG. 13

piece. Carefully nail this in position with flat-headed nails, and bind round the end with a strip of tin or thin iron. Bevel off the front edge of the scoop until the thickness does not appear, so that the scoop will be forced the more easily into the grain.

Dairy Table (Fig. 14).—A simple form of table of home construction, frequently found in country districts, is one shown in Fig. 14. It is made from two pairs of crossed legs, braced together underneath to preserve the most essential feature in a work table, viz. rigidity. Cut off four pieces of wood 3 ft. 6 in. long and 2 in. square and cross-halve them (A) in the middle, so that at

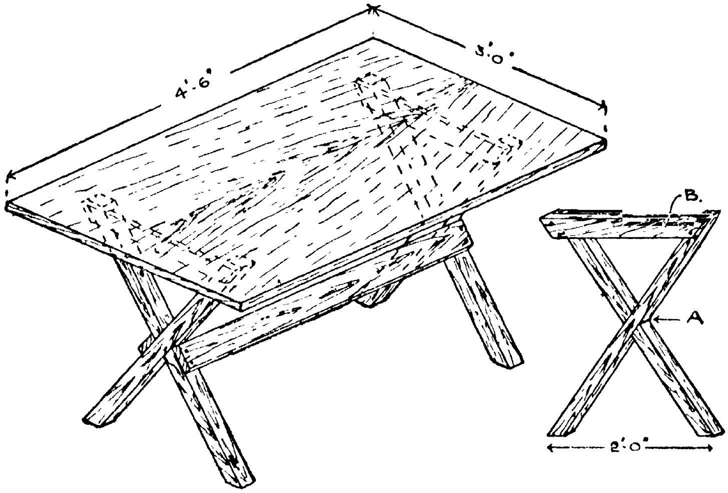


FIG. 14

the top they are 2 ft. apart and the same at the bottom. Cut two other pieces of wood ¾ in. thick, 2 ft. long and 3 in. wide, and screw these across the top of the legs as shown at B. Saw and plane the tops and bottom of the legs so that they are horizontal. Now brace the legs together at the centre by screwing on each side a piece of wood 4 in. wide × ¾ in. thick × 3 ft. 6 in. long. The stand is now ready for the top to be fastened to it; which should be done by screwing through the top into the rails (B) or from the underside of the rails into the top by driving the screws in askew. In addition, to prevent the top from warping, and to hold the pieces forming the top the better together, battens may be screwed on the underside of the top across the fibres. It will be well also to dowel the pieces of the top together before fixing to the framework.

Garden Harrow (Fig. 15).—This implement is one that saves a vast amount of labour in harrowing a garden after it has been dug ready for planting. It acts in a smaller way like the ordinary field harrow; but instead of being one for horse power, it is intended for hand power. The rings and rope attached to the front constitute the means of dragging. The framework is made from five pieces of strong heavy timber (oak or beech), halved together as shown at A in the figure. Three pieces should be 2 ft. 6 in. long and two pieces 2 ft. long, and all about 3 in. wide and 1¼ in. to 1½ in. thick. When the framework has been constructed, bore seven holes 4 in. apart in the front and back pieces, smaller than is required for a good stout 6 in. round wire nail. In the middle bar bore six similar holes, arranging them so that they are opposite to the spaces of the front and back bars. When this is done, drive a 6 in. round wire nail through each hole. Along the top of each of the three cross bars screw a piece of wood ½ in. thick to prevent any tendency of the nails to come out. Fix a good strong cord to the front as shown in the sketch, and the implement is ready for use.

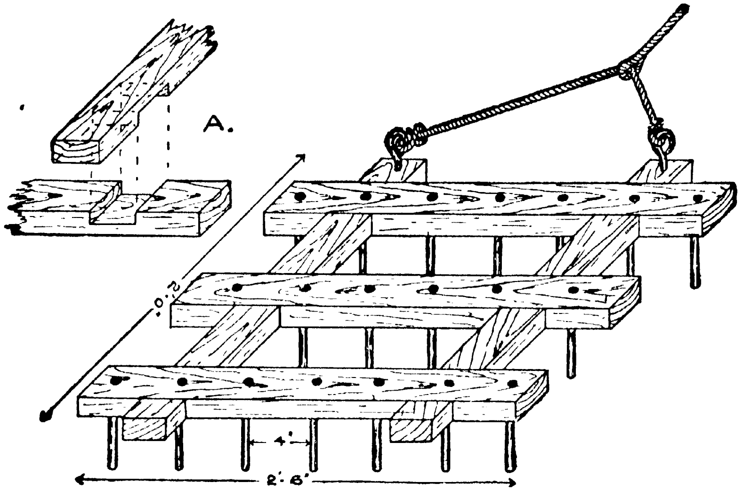


Fig. 15

Lifting Jack (Fig. 16).—This is a useful model for lifting carts, etc., when adjusting or cleaning them. A post about 2 ft. 6 in. to 3 ft. high and 3 in. × 6 in. is mortised into a suitable base, and supporting blocks (A) fixed all round. The slot for the lever is made about 2¼ in. wide and 8 in. deep ; three holes ⅝ in. diameter are bored through each side, corresponding with one another, in order to carry the pin which adjusts the height of the lever. The lever itself is about 3 ft. long, 2 in. thick, and 3 in. deep. The handle and toe of the bar are shaped according to the sketch. In order to strengthen the holes in the sides of the post it would be well to face the outside with some thin sheet iron. The lever pin is made from 10 in. of round iron as at B ; or a simpler form can be made by flattening the end of the rod, and drilling a hole as at C. This pin should be attached to the side of the lever support. Three holes should be bored through the side of the lever for the pin to pass through, and if possible the sides of the lever about this part should be faced with sheet iron in the same way as the sides of the post were faced.

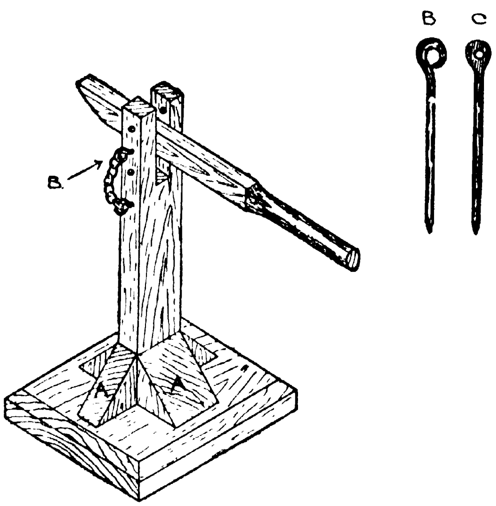


Fig. 16

Rustic Work

Its Value.—The value of this kind of work lies in the fact that the material is easily obtainable in country districts and that it is easily worked. No great demand is made on manipulative skill in the use of tools, but the exercise of care and thought are needed for the production of well-made models. Rigidity and stability are two of the essentials in constructive work of this character. Another advantage is the artistic and natural appearance of the material. Fences, gateways, and many other objects may be made in this natural wood, and a more artistic setting is given to the surroundings than when such objects are constructed merely for use. There is no reason why, as well as being useful, an object should not be given a "natural" touch; more especially where surroundings are so unspoiled by the hand of the artificer or the marks of the machine.

Tools.—The tools required are very simple; chief among them being the knife, the saw, and the hammer. A little practical experience in the use of the first of these, and in the nature and possibilities of the material, will suffice to put the worker in a position to do a great deal of the work outlined.

Garden Sticks (Figs. 17, 18 and 19).—Simple and effective sticks for various garden purposes may be made from natural wood, twigs, boughs, etc. Fig. 17 shows a common form of plant label, which is made by splitting down the middle a twig about ½ in. in diameter, and smoothing it off with a knife. It will be best to shave off the rough wood below the pith in order to obtain a smooth surface on which to write. Fig. 18 shows a layering stick used for layering carnations. This is a stick of natural growth with the remains of a branch twig (A) projecting. All that is required is for it to be trimmed up and pointed. In Fig. 19 is shown a pliable twig (willow, poplar, or ash), used at the end of a row of peas; one is placed at the end of each row, and black cotton stretched from end to end and tied to these bent twigs. All that is required here is for the ends of the twigs to be pointed.

FIG. 17

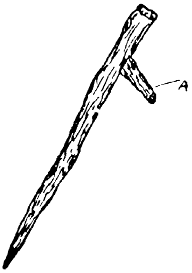


FIG. 18

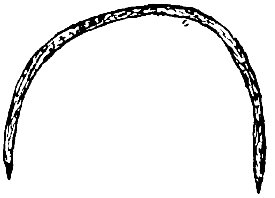


FIG. 19

Line Winder (Fig. 20).—Where prepared wood is not easily obtainable a line winder may be made from two pieces of natural wood. These are cut to fit each other near the middle, somewhat after the manner of a cross-halving joint, and firmly nailed or screwed at this point.

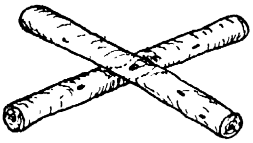


FIG. 20

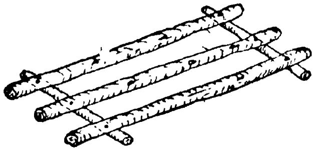


FIG. 21

Flower Pot Stand (Fig. 21).—Another simple model and one capable of elaboration into a flower pot staging is that shown in Fig. 21. The sketch is self-explanatory, and no instructions as to making it are needed; suffice it to say that the pieces of wood composing it should be as straight and regular as possible.

Plant Ladder (Fig. 22).—This is quite a common model in house window flower pots for fuchsias and similar plants, but few people seem to employ natural wood for it. The central stake will determine the size of the model, which may be small for a flower pot or large enough for a garden plant running to several feet in height. The strength and thickness of the twigs used will depend on the size of ladder to be made. The nailing should be carefully performed where a small ladder is made, and if necessary the nails must be clinched at the back to prevent the pieces coming apart.

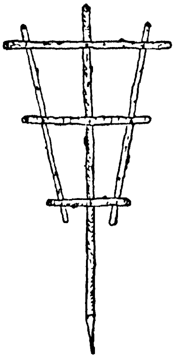


FIG. 22

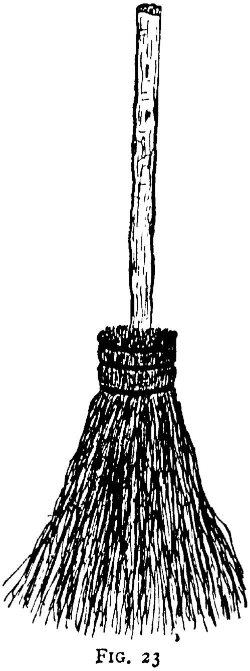


FIG. 23

A Garden Brush (Fig. 23).—After having gathered sufficient birch twigs, or others suitable, to make the garden brush or besom, arrange them round a stale or handle. This latter may be an ordinary broom-stick or a fairly straight tree branch. Divide the twigs uniformly round the stale and bind tightly with galvanised iron wire. Wire is preferable to the usual twig binding as it can be tightened better and the twigs bound more securely. In order to prevent the handle from coming out, the binding wire should be securely fastened through the handle, leaving a free end to which the other end may be twisted when each piece of binding is finished. Three bands are shown in the figure, but four or more may be employed if necessary.

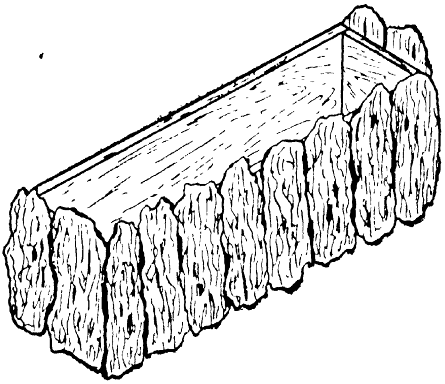


Fig. 24

Window Box (Fig. 24).—A box of a suitable size for the window-sill is obtained (a grocer's currant box serves very well) or one should be made to fit. In either case the front side and two ends are covered with cork bark or split branches of trees. This is done by means of galvanised iron nails, and as a window-sill usually slopes outwards, two pieces of wood should be nailed or screwed to the bottom of the box, so as to make the box stand level on the sill. When this has been done, the cork bark or split twigs should be arranged and fixed in such a way that they will hide the two battens fixed to the bottom: that is, they will project below the bottom of the box to a depth equal to the depth of the battens. If this box is not intended for a window sill, it will possibly be better to cover all the sides instead of the three shown.

Rustic Tubs (Fig. 25, 26).—Ordinary butter tubs, or similar ones, may be made to look very effective in a garden or walk by fixing to them split or whole pieces of branches or cork bark. The latter is more effective when arranged in " disorder," while the former look well when worked into some geometrical pattern or design as in Fig. 26. A combination of whole and split branches or cork bark or ordinary tree bark gives a very effective and "rustic" appearance.

These same tubs make excellent garden vases if mounted on a good stout tree stump, sunk firmly into the ground, and supported on each side by smaller pieces nailed to the stump at an angle of about 45°, and wedged in the ground with brick-bats, etc. These vases are frequently found in gardens and lawns, and do not offer any difficulty to the "handy" man.

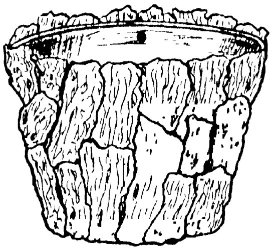


FIG. 25

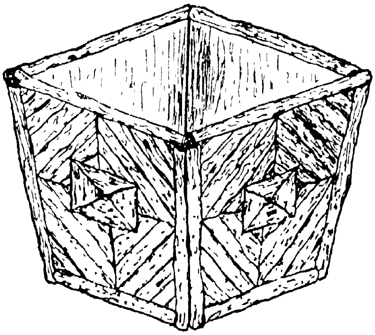


FIG. 26

Smaller boxes may be made with or without a bottom, and ornamented in the same way as the above. These smaller boxes serve very well as covers for flower pots to stand inside, and are suitable for the garden or the house and hall.

Gipsy Kettle (Fig. 27).—This is a simple stand of three pieces, wired near to the top to resemble the tripod used by gip-

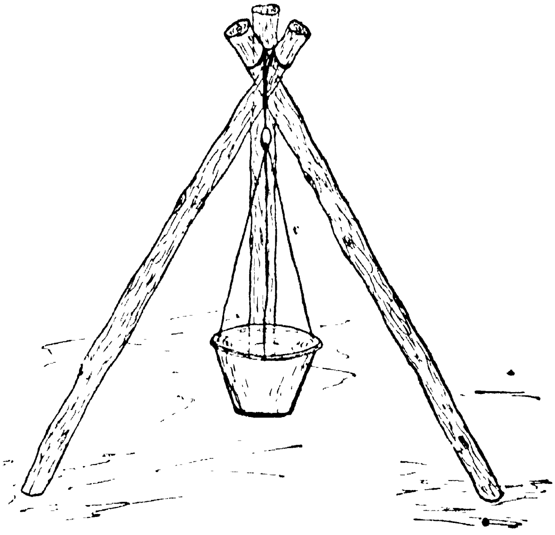


FIG. 27

sies. A wire loop is left hanging from the centre, where the three pieces are bound, and on this the flower pot or basket is suspended by three wires. An ordinary tree-pot, if planted with some form of hanging foliage, looks well; while if some climbing creeper grows in it, it will find its way up the wires of the suspended pot and over the poles forming the tripod, thus giving it an artistic setting. These tripods may be made any size, and the tubs and boxes shown in Figs. 25 and 26 may be substituted for the ordinary flower pot. The advantage of the above model is that it can be very readily moved from place to place.

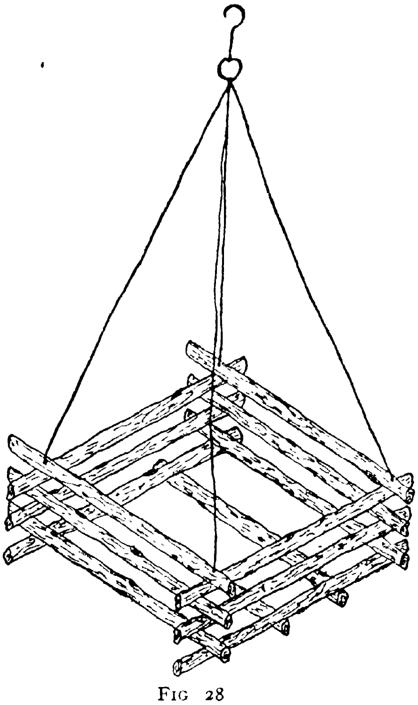


FIG 28

Hanging Basket (Fig. 28).—Baskets such as the one sketched in Fig. 28 are made from branches about ½ in. thick, and as far as possible uniform in thickness. The shape may be arranged according to wish, as this is dependent on the length of the pieces and their arrangement. The basal shape having been decided upon, it becomes a matter of taste whether its sides slope inwards or outwards, and whether they are straight or curved. The principle on which the baskets are constructed is this—bore a hole near to the ends of the sticks, and through these holes thread a piece of galvanised iron wire with a ring bent on the end of each, one wire for each corner. When all the pieces are threaded, cut off the wires the required length, and bend a loop or ring on the top end; or gather the wires together into a larger ring at the top for hanging purposes.

Rustic Bridge (Fig. 29).—A plank bridge is often found in country districts, and is not difficult of construction. Six or eight

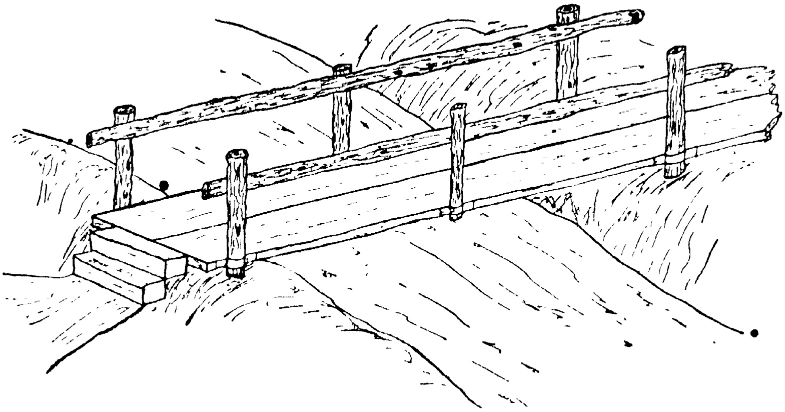


Fig 29

uprights will be required according to the length of the bridge. The two at each end should be fairly stout and sunk into the ground, and fastened to the plank by strips of thin iron round the post, and nailed to the plank. The middle posts should be fastened to the plank in a similar manner. A long hand-rail (or two if necessary) should be fastened to the upright posts with good screws, and bound round with thin iron strips and these nailed. The spaces between the posts may be filled in with shorter pieces in irregular manner if desired.

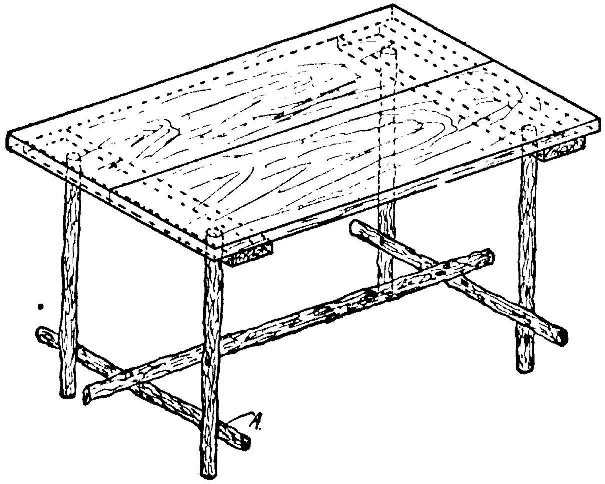


Fig. 30

Rustic Table (Fig. 30).—A simply constructed table may be made as shown in Fig. 30. Four legs of sound timber are selected and joined in pairs by a foot-rail (A), with good screws. Holes are bored in two battens into which the legs fit tightly. These battens are screwed to the underside of the table top, and nails are then driven through the top down into the tops of the legs. A stay should be screwed to the two leg rails to give rigidity to the legs, If the table is a large one, supports should be fixed diagonally from the middle of the underside of the table to the leg rails, which will render the table more rigid still. In the drawing the legs are shown upright, but they may also be fixed wider apart at the bottom than at the top to further increase the stability.

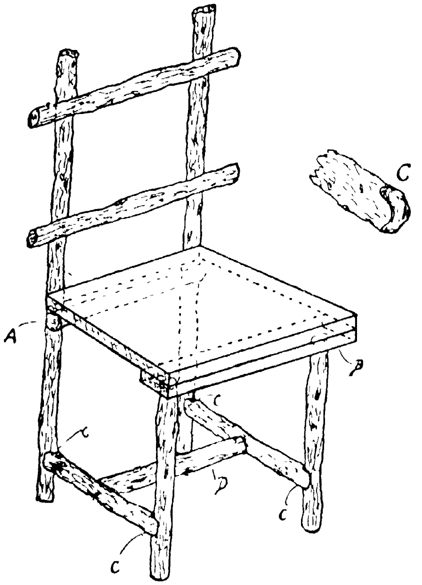


FIG 31

Rustic Chair (Fig. 31).—A piece of ordinary wood should be used for the seat, and it may be square or slightly narrower at the back than at the front. For the framework of the chair, obtain two pieces of rough bough about 2 ft. 9 in. long, and eight pieces about 18 in. long. Commence with the back by screwing the top cross piece to the long legs, and next fix the rail (A) on which the seat is to rest, about 16 in. from the bottom. Then the other back rail can be fixed, a little nearer to the top rail than to the bottom one (A). Cut off two pieces for the front legs the same height as the seat rail; bore two holes in the batten (B) to receive the front legs, and wedge in position. Next screw the seat to front and back rails. Cut two supports for the legs, and shape the ends of these hollow to fit the legs closely. Drive a good nail through the legs into these rails. Arrange a cross rail (D) to fit between the leg rails, and fit to them as in the other cases. Use bronze or blue screws, and cupheads if thought desirable.

Tree Protector (Fig. 32).—The ugly fences one frequently sees erected round trees to protect them from damage by man or beast may have as substitutes others which, at any rate, are more in keeping with the "natural" surroundings. Fix three or four or more posts, according as to whether it is desired to construct a triangular or square fence, into the ground around the tree it is desired to protect. It will be well to dip the ends of the posts in tar before fixing them in the ground, in order to prevent rotting of the wood. Smaller twigs or branches are cut and nailed on to these posts to show either a regular trellis pattern or an ordered irregularity. In nailing on these smaller pieces, a weight of some sort should be held at the back of the post where the nail is being driven, so as to reduce the chances of shaking the structure and rendering it unstable.

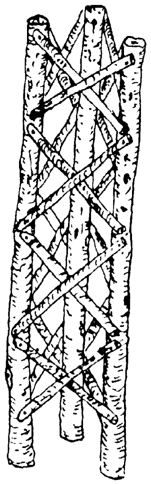


Fig. 32

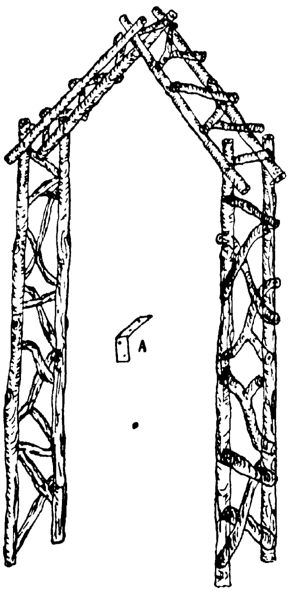


Fig. 33

Trellis Archway (Fig. 33).—Archways of the type shown in the sketch may be constructed by fixing fairly stout natural wood into the ground, packing well round with brick-bats, and beating the earth tightly round the foot of the posts. The sides and top section may be made separately and fixed together when they are made. Similar precautions will have to be taken, as when making the tree protector. It may also be advisable if the structure is on the "heavy" side to use several angle-irons (as shown at A) to support the larger pieces of wood. These should be nailed or screwed on the underside of the wood. As an alternative to this, the larger pieces may be bound with thin sheet iron—such as is used for packing cases—and nailed thereto.

Rustic Gate and Fence (Fig. 34).—The size of the gate will be conditioned by the width of path desired, and the height by factors which make a gate necessary. Two good sound posts 4 in. to 6 in. in diameter should be well soaked in tar at the bottom before being inserted in the ground. If tar is impracticable the ends may be charred in the fire instead; this will serve equally well. Pack these well in the ground, by battering in brick-bats and clinkers, and see that so far as possible they are parallel to one another and upright. If a fence is to be attached, similar posts will be required at the other end, unless a wall or some other object will serve as a stay to which the long cross rails may be fixed. When these are fixed in position, the wickets (A) of split branches may be nailed to them. As an alternative to wickets irregular pieces may be attached, giving a less formal appearance (B). The gate may be either of the wicket pattern as shown in the sketch or it may be made with a strong frame of side posts and cross rails, and filled in with irregular branches similar to the fence described above (B). As an addition an archway may be attached to the gate-posts and a climbing plant trained to grow round it.

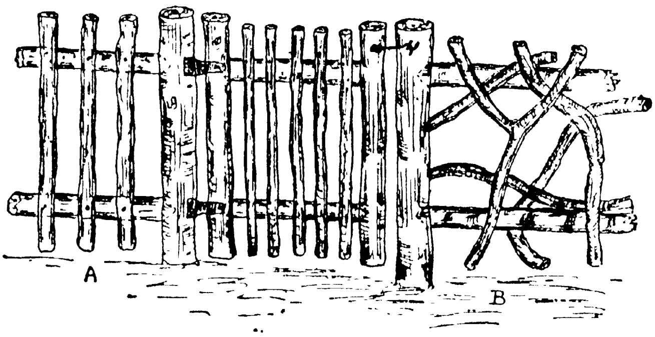


FIG. 34

Rose Bower (Fig. 35).—In Old English Gardens and in some modern imitations of them a rose bower is no uncommon thing. This is made by either fixing posts in the ground where necessary, or utilising existing trees where suitable. The main thing is to have an irregular trellis work of branches and twigs, not too close together, in order that the rambler or climbing rose may spread

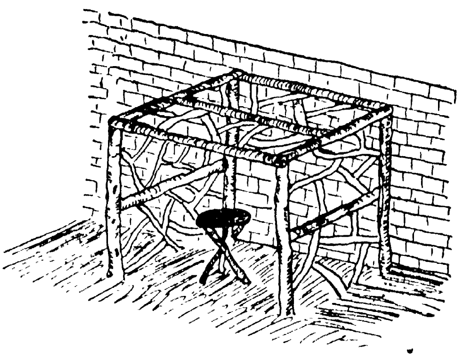


FIG. 35

itself over the whole structure—the rose trees being, of course, planted so that this may be accomplished with due care and training of the young shoots. Eventually in the rose season the structure becomes a "bower of roses," which completely envelop it.

The one shown in the sketch is fixed against a wall, but modifications to suit individual needs and tastes may be similarly constructed. A continuous archway or tunnel may be made by fixing posts along a path, and connecting these in a manner similar to that shown in the sketch. It is essential to see that the heavy supporting pillars are well and firmly fixed in the ground, or it is possible that the structure, under stress of storm or wind, may collapse. Smaller structures of the same kind make effective "clumps" on which other climbing plants may show themselves off—such as Sweet Pea, Canary Creeper, etc.

Field Shelter (Fig. 36).—On large farms where cattle and sheep are left out in the fields all night and in all weathers, rough shelters are very convenient. The essential feature is to have the corner posts firmly fixed in the ground, and the cross pieces for holding and bracing the whole structure together firmly and rigidly fixed to these. A substantial cross piece should run from one front post to the other, and from one back post to the other, joining the tops. At the back also one will be needed across the bottom, and one across the middle.

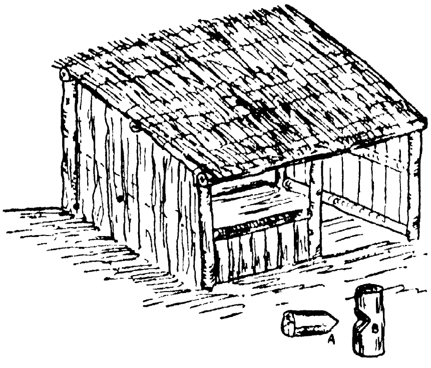


FIG. 36

The same will be necessary for the sides - these are indicated in the diagram, some in dotted lines. The front is open entirely on one half, and half open on the other half.

The method of fixing the larger posts is shown in the diagram at A and B ; the end of one piece (A) is cut in a wedge shape while a niche is cut in an upright piece (B) to fit this. This is afterwards "spiked" by driving long nails through *each* piece into the other at convenient places. The sides are boarded up with rough tree trimmings, which may easily be obtained from the forester, or when the merchant is preparing timber for market. A rafter (or several if necessary) is placed across the top of the structure, and either rough tree trimmings, twigs or straw, or a combination of these, used to cover the shelter. If straw and twigs are used, the roof may be "thatched" by using coco-rope, which is common enough in the country. To preserve the wood, the whole structure may be given a coat or two of tar.

METALWORK

Some General Hints.—A few general hints on the chief processes employed in this section will not be out of place.

Forging.—When this is necessary care should be taken to avoid burning the iron by allowing it to become too hot. A clean fire also is essential ; that is, clinkers should not be allowed to form in the fire, or when they do form they should be cleared out with a poker or rake. In forging a point care should also be taken to commence at the end of the iron in order to weld up the fibres. If this is not done the iron will not close up afterwards, but fray out like the untwisted fibres of a rope end.

Riveting.—In riveting it is necessary to see that the rivet fits the hole without being too tight. When the actual riveting is being done, the rivet should be hammered round the edge, and the hammer gradually worked towards the centre, so as to spread the head evenly over the sides. Care should also be taken to prevent the edges of the head being frayed and split. These remarks apply to hot or cold riveting.

Soldering.—The one important essential in this work is cleanliness—clean iron, and clean surfaces to be soldered. The iron to be "tinned" is heated—not to redness—and dipped in the spirit (or for boys preferably "Fluxite"); then it is put on to the solder, and the copper covered by a thin layer of solder. The parts to be soldered should be cleaned—with emery if necessary—and smeared with "Fluxite" or spirit. The tinned iron is then held on the parts to be soldered, to heat them, and gradually drawn along the joint. When the joint is finished it should be wiped with whitening or chalk, washed, and wiped dry.

Stable and Wall Hooks (Fig. 37).—Useful hooks for the wall may be made from a disused hurdle or from a bar of iron from an old "unclimbable" fence. Other scrap metal may often be employed to advantage. The essentials of a wall hook are a good driving point and a suitable end for the front. First heat the end to be pointed, and hammer out to a point with four sides—that is, pyramidal—or flatten on top and bottom sides to make a chisel point or wedge shape. This latter is the more suitable for driving in between courses of bricks; but in either case when making the point, begin by hammering the fibres together at the end, and gradually working away from the point. Having done this, cut off the length of iron required for the complete hook, and turn up the end as at A or B (Fig. 37), according to need. It may be desired to forge an "eye" or ring at the end as at C; in that case a sufficiency of rod must be left to form the circle.

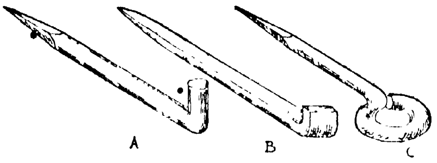


FIG. 37

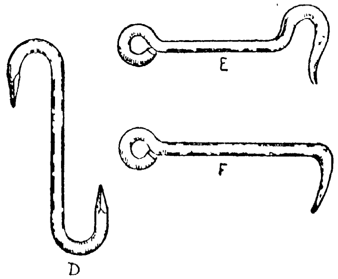


FIG. 38

Ceiling Hooks are made by turning a hook on each end of an iron rod after having pointed the metal at each end by hammering (Fig. 38 D). The ends are turned, as shown in the sketch, in the same plane but in opposite directions.

Gate Hooks (Fig. 38, E and F) are made usually from ¼ in. round iron; an "eye" is forged at one end, and a hook at the other

—as seen in the diagram. The hook may take the form of a bend and curve, or it may be a simple bend as seen at F.

Poker (Fig. 39).—A simple poker suitable for boiler fires may be made by turning an "eye" on one end of an iron rod ½ in. in diameter, and pointing the end slightly. Both these processes are performed after heating the iron to redness, and working the operations on an anvil or an improvised one. A rail from a disused fence will form an excellent medium for this model.

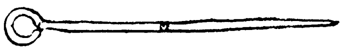


FIG. 39

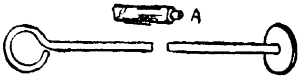


FIG. 40

Sewer Scraper (Fig. 40).—In country districts and on the farm, a small sewer or drain is often laid by others than sanitary experts, and frequently, as might be expected, these get choked, and a scraper, such as the one shown in the sketch, is very useful. An "eye" is forged at one end of the handle, or it may be omitted if thought desirable. On the other end a round disc of sheet iron is fixed. This is done by drilling a hole a little smaller in diameter than the shaft, and filing a collar (A) on the end of the shaft so that when the smaller rivet is driven though the hole in the disc, it may be riveted on the opposite side. The size of the disc will of course vary according to circumstances, but 4 in. would be a useful size.

Handles (Fig. 41).—It is sometimes convenient to be able to fix handles to tubs, barrels, and heavy boxes. Such handles may be made from material similar to that used for wall and stable hooks. The ends are flattened out as in A and B, and these flattened pieces drilled to take a stout screw. The shape (half-round or square) is a matter of choice.

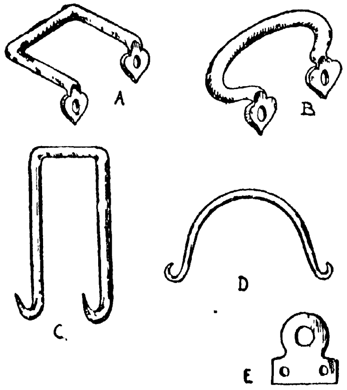


FIG. 41

A Sack Lifter is shown at C (Fig. 41). It is a modified form of A. It is made wide enough for the hand to grip comfortably, while the two ends are pointed and turned up in order to stick into the sacking.

A Bucket Handle (D) is also a modified form of A. A stable bucket may be made from a grocer's lard bucket or tub. Plates with holes (E) should be screwed firmly on to the sides of the bucket, and a handle made to fit the same.

Foot Scrapers (Figs. 42, 43).—This model may be made in one piece of metal by bending, as shown at A, a piece of round or rectangular iron rod. The arm B is forged with an edge on the top, which is to form the scraper. At the end of this arm forge a point for driving into the wall. The square end at the bottom of the upright piece should be fixed into the ground, and well packed down with brick-bats to keep it steady. In fixing, of course, the pointed end of the arm is first driven into the wall and then the upright is firmly packed in the ground.

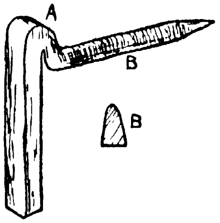


FIG. 42

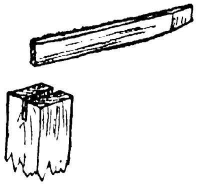


FIG 43

Another and perhaps simpler type of scraper is made by driving a piece of iron about 9 in. long, 2 in. wide and ¼ in. thick into the wall, and allowing the other end to rest in a groove cut in a piece of wood, which is embedded in the ground. Forge a chisel edge on one end of the iron blade and cut a groove in an upright piece of wood (about 2 in. square), as shown in the figure, just wide enough to take the blade. When the iron has been driven into the wall the wood post is fitted and fixed in position—it should be soaked in tar (to prevent decay), and well rammed about with brick-bats.

Horse Scraper (Fig. 44).—A handy scraper for grooming a horse is made from a piece of hard brass (A) or polished hoop-iron about 1¾ in. wide, 8 in. long. This is fastened to an iron shaft (B), which is fixed into a wooden handle. For the shaft obtain a piece of iron rod about 6 in. long and ⅜ in. in dia-

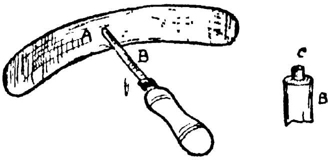


FIG. 44

meter. At one end of this file a rivet and collar (C) and at the other forge down to a square tapered point. Drill the blade in the centre with a hole to take the rivet (C) and rivet the blade on to the shaft. The blade should be filed smooth, the ends rounded as shown in the drawing and polished with emery cloth. The shaft should now be driven into a suitable handle—a portion of a broom stalk, shaped, and either bound with wire or a ferrule fitted on the end. The curve shown in the figure may be strengthened by hammering with a round pane hammer along the middle on something hard, in order to make the blade very slightly convex on the outside.

Milk and Cream Cans (Fig. 45).—Very useful tins are now supplied by tradesmen containing various commodities, and these tins can be made useful about the farm or home by a little work on them. A tin is sometimes obtained which requires a lever to lift the lid. In order to render this serviceable as a paint can, solder a piece of tin (A) on either side at the top, and make a handle of wire by bending into shape. Small canisters can be treated in the same way, and used for small quantities of milk or cream, particularly if there is a good lid.

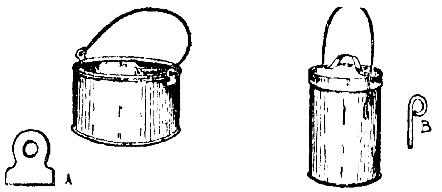


Fig. 45

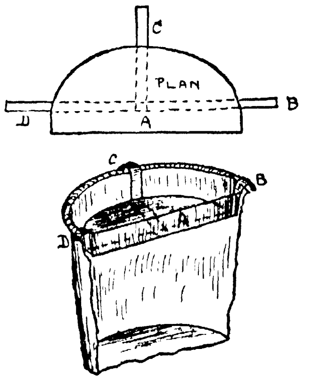


Fig. 46

Solder a piece of wire, shaped as at B, on the sides of the can below the reach of the lid. Through these "eyes" the handle is made to work. Shape a handle, and solder on to the top of the lid, but in order to prevent the edges of the lid handle cutting any one, bend over its edges on to the inside.

Pail Brush Holder (Fig. 46).—This is a "tidy" for hanging on to the top rim of a bucket, to hold brushes, soap, etc. Cut out a piece of tin-plate (or thin sheet iron) to fit an ordinary bucket, allowing for a piece to turn up (A) to prevent articles from falling into the water. The depth of the turn-up should be about 2 in. and the whole tidy should, when fixed in position, extend over about one-third of the bucket. Two pieces of strip iron—that usually used for binding boxes will do very well—should be riveted together at right angles as shown in dotted lines in the plan, and the sheet metal again riveted to these strips. The extended strip (B, C, D) should be bent over to clasp the rim of the bucket, as shown in the diagram. It is obvious that the bends (B, C, D) are not made so that the tidy is in place permanently, but that it may be used with and removed from any bucket.

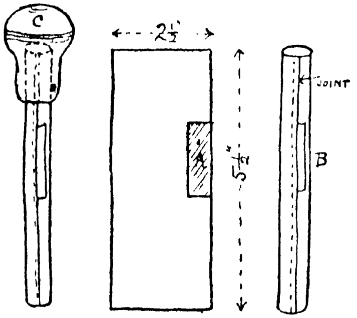


FIG 47

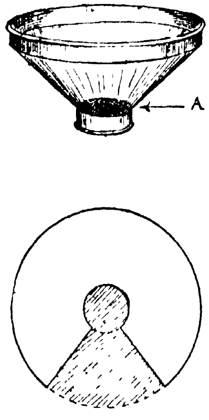


FIG. 48

Apple Corer (Fig. 47).—This is not so difficult a model as may appear. Cut out a piece of thick tin-plate about 5½ in. × 2½ in. and from one side of this cut out a piece as shown in the shaded portion (A) of the diagram. Bend this tin into a cylinder about ⅝ in. in diameter, round a rod or tube, and solder, so as to leave an opening for the core to be cleared from the tube (B). Bore a hole in a wooden handle (C) the same diameter as the cylinder B; and about 1¼ in. deep. Fit the tube into this hole and plug with a piece of wood to fit the inside of the tin tube. Take care that the plug does not fit too tightly, or the handle may crack. Before using this model, see that all the exposed edges of tin-plate are carefully "tinned," or rusting of the iron will ensue.

Milk Strainer (Fig. 48).—The most difficult part of this model to construct is the conical portion. The easiest way to do it—the empirical way—is to cut out a ring as shown in the lower part of the diagram, and from this to cut away (the shaded portion) just as much as will be necessary—this will be found by trial—to make the remaining piece into a truncated cone when it is bent up into position. When this has been done satisfactorily and soldered, two bands of tin are required, one for the top, and the other for the bottom. Wire one edge of each band and solder the parts together as shown in the drawing.

A piece of brass wire gauze must now be cut in order to fit at the bottom of the conical portion (A) and soldered in position. In order to prevent rusting, the edges where the tin has been cut should be "tinned" by running over them with a tinned iron.

A modified form of this model might well be made in tin-plate, for use as a funnel or tun-dish, but with a long neck.

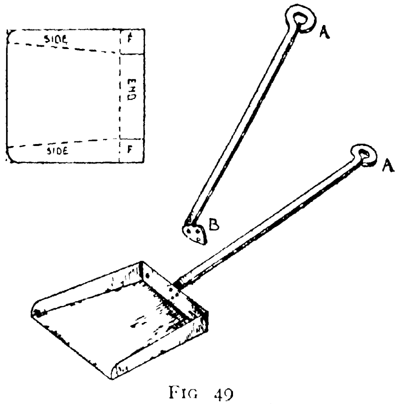


FIG 49

Fire Shovel (Fig. 49).—From a piece of thin sheet iron cut out and bend up the body of the shovel. The plan is shown in the upper part of the figure. Bend up the sides and end along the dotted lines; the pieces marked F are to be bent round the back of the end, and drilled and riveted to it. The handle is made from either round or flat iron bar; a ring for hanging up the shovel is turned at the top end (A), while the bottom end (B) is flattened out and bent down almost at right angles in order to give the desired angle to the shovel when fixed in position. Drill a hole through the middle of this flattened end, and another of the same size through the middle of the back. Make a rivet to fit these holes, heat it and rivet the two pieces together hot. It may of course be done with the rivets cold, if the other metho is impracticable.

Dust Pan (Fig. 50).—This is very similar in construction t

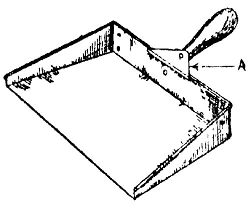


FIG. 50

the fire shovel, though the shape is slightly different and tin-plate may be used instead of sheet iron. Plan out the metal according to the desired size, and bend up the sides and back into position. If tin-plate is employed, wire the edges and solder the parts together. If sheet iron is used, rivet the sides and back together as for the fire shovel. To attach the handle, which may be made from a piece of broom handle, use a good nail with a good flat head, and drive it through a drilled hole in the back—in the case of sheet iron—or force the nail through the tin into the handle. In order to support the handle, solder the end of a strip of tin on to the back, at each side of the handle, and nail the other end to the sides of the handle. Also solder a triangular piece to the back, and nail the point of this to the handle (A). If the body has been made of sheet iron, then it is useless to try solder for this purpose, and, therefore, rivets must be employed.

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XLVIII. STRING WORK

By Miss C. Ferris

Principal and Head Mistress of Westbourne House School, Penarth

Its Educational and Practical Values.—This interesting branch of educational handwork has some very considerable advantages. It forms an attractive class subject, in which the children usually take great interest. It can be adapted to children of very different ages. It has been very successfully taught to children of five and six years old, and makes interesting employment for boys and girls over ten years of age.

Including as it does bead-threading and all the work that can be done with the different sizes of macramé twine, it gives much scope for appreciation of form and colour, and also for original designs. The varied colours of the beads and the string will satisfy the child's craving for colour, and provide useful material for training in the selection and combination of colours. Art revels in colour, and we are always trying in our gardens, our houses, and our clothing, to find the best colour effects. When Froebel prepared his material for the kindergarten, colour was for the first time introduced into a system of elementary instruction disconnected from drawing and painting.

It gives the children the power of working with their fingers deftly, accurately, neatly, and nimbly, and has the advantage of requiring little in the way of tools besides the child's own fingers. It also has the advantage of training the fingers of both hands at once in precision and suppleness. In the more advanced knotting and macramé work the children should be encouraged to train their judgment by using their past experience as a guide for deciding the lengths of string necessary for the work to be done and the combination of knots most suitable for the efficiency of the article to be made.

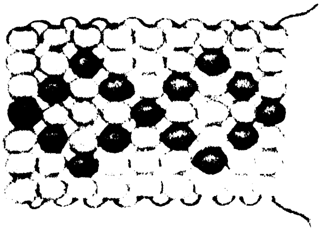


Fig. 4

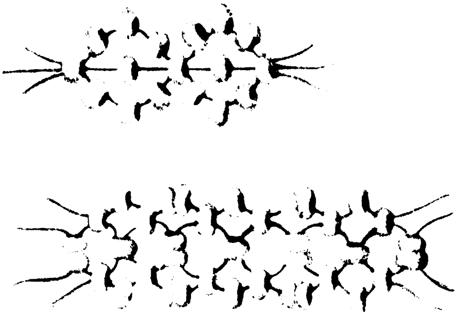


Fig. 3

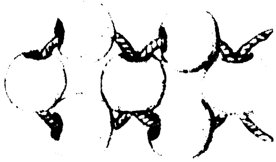


Fig. 2

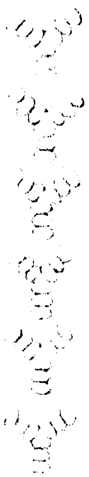


Fig. 7

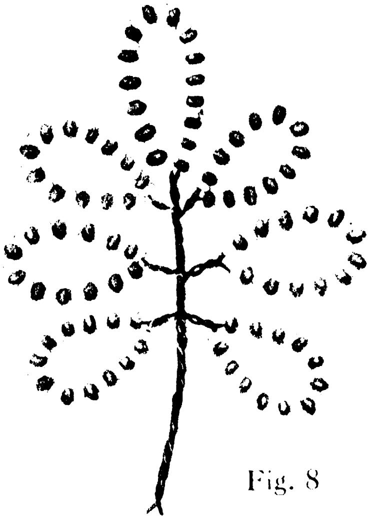


Fig. 8

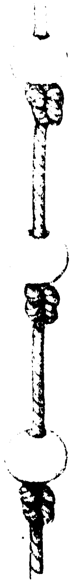


Fig. 22

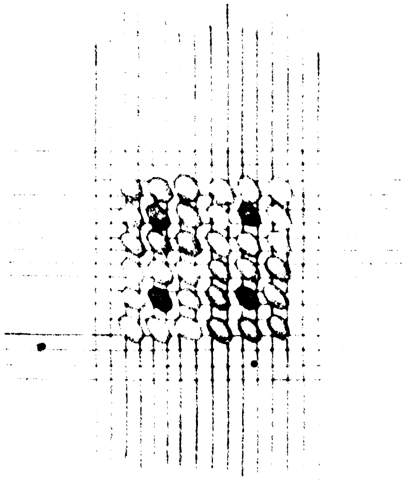


Fig. 5

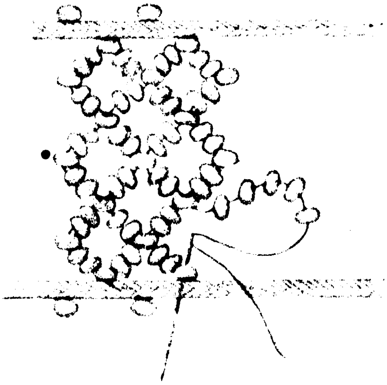


Fig. 6

BEAD WORK. ELEMENTS AND DESIGNS

S.B.

Elementary knotting and bead work, or the two combined, can be made excellent use of for training in number, and even and accurate spacing and measurement. For instance, tying single over-hand knots in a length of string at even distances of 1 inch impresses the idea of the inch very definitely on a child's mind.

The tying of knots and making of splices in cord for various uses can be used to illustrate some of the simpler mechanical principles, such as levers, friction, the power of the wedge, and the equality of the strain on every part of the rope.

The subject is a valuable auxiliary to domestic crafts, ensuring, as it would do, a knowledge of the best methods of handling all the ropes, lines, and strings in use in an ordinary house, from the safe fixing of the possible fire-escape rope to the fastening and repair of the common clothes-line.

In the garden, also, its uses are manifold, including the tying of plants and trees, the making of fruit-nets and hammocks, and the use of strings instead of sticks for various climbing plants.

It appeals also to the lover of outdoor sports, from the time when as a boy he uses a piece of twine, or whip with a string lash for his tops, and more string for his kites, to the time when he can make his own tennis or cricket nets, bind his bats and hockey-sticks, join his fishing-lines, and master the knowledge of rope-joining necessary to an accomplished yachtsman.

Its History.—String or cord made from different vegetable fibres twisted together seems to have been used at different periods of man's history in different localities. Some of the implements used in the stone and bronze ages had their parts tied together with string. Doubtless the earliest method was to use thin strips of leather for this purpose. But string made of flax, not hemp, has been found in the remains of the Swiss lake-dwellings, knotted into fishing-nets. The present Australian natives make excellent fishing-lines by twisting a fibre much resembling coir in appearance. Some of this native twine is very fine, and is used for threading native beads. An arrow-head from the Swiss lakes was attached to the shaft by a ligature of string (Fig. 1). The American aborigines, in the time of Christopher Columbus, obtained fire by drilling sticks into holes in dry wood; and among the American Indians of more recent times it was a common practice to make a bow to turn this drill with. The string for the bow was made from a thin strip of leather. Thongs of leather were used in Scotland as late as the third century, for ships' cordage. But in the south of Europe long prior to the time of Cæsar the manufacture of cord from vegetable fibres was practised.

FINE TWINE OR THREAD

Bead Work (from the Anglo-Saxon *beade*, a prayer).—The small balls now called beads, either made of iron, pearl, garnet, amber, or crystal, were used as ornaments in prehistoric times, while glass beads were made almost as soon as the art of making glass was discovered. The Egyptians, Greeks, and Romans made use of them as ornaments, and the Druids before the Conquest of Britain used annulets, or large perforated balls of glass, in their religious rites. The English name of bead came from the practice of using these strung balls for telling off the number of prayers recited.

The greater number of beads used in bead work are made at Murano, near Venice, but there are also manufactories in Germany and England. Large quantities of coarse beads are sold to the natives of America and Africa, for embroidering their garments, etc., and the taste displayed often puts to shame the work of more civilised nations. For a long time beads for needlework were made with but few varieties of colour, but during the last hundred years many additional colours and sizes have been manufactured, thus giving a much greater scope in their arrangement.

Bead Threading.—The first and simplest work under this heading is bead threading. Done with large-sized beads (*e.g.* ·7 or ·8 cm. in diameter) this forms a valuable occupation for children of kindergarten age. The knowledge of colours and their tasteful combination, and the scope for working out original designs are important features in this work, as is also the practice it gives in elementary number. A first simple exercise is the threading of large beads on one string in a certain order of colour, *e.g.* the primary colours to start with. Curtain chains can be very simply made in two contrasting colours. Fine macramé twine should be used, and the ends finished off with brass or bone rings (see Fig. 2). It is well to fasten the thread, doubled, on to one ring before commencing the chain.

Smaller beads require finer thread, and are only suitable for older children. Very fine bead threading is bad for the eyesight if done at all continuously. The threading should be done with a fine straw needle, and a large variety in colour and design can be obtained. A pretty necklet can be made to imitate daisies, white with yellow centres, to which may be added some green beads to represent the grass. Fig. 3 gives the detail of these, sufficiently enlarged and with beads separated, to show the mode of threading. For the first design three threads knotted together are required, and for the second four threads. Fine linen thread or silk should be used, and it must be fine enough to admit of the threaded needle passing through a bead which has already three threads running through it. By selecting beads with rather large bores this may be easily done.

Fig. 4 shows a design which may be used conveniently for a serviette ring. Fine wire may be substituted for thread, with good results, where greater firmness is required. This applies generally.

Thirty years ago the art on the Continent was carried to great perfection, very minute beads being used, and worked into flower patterns of great delicacy. The beads are generally sewn on fine canvas (see Fig. 5). They must be sewn singly with fine waxed sewing silk with a tent stitch across two threads of the canvas on the slant. Berlin patterns may be obtained, but they are mainly floral, and the work is better suited to geometrical patterns. It is very lasting, and is easily cleaned with a damp sponge. Damp does not spoil it, and the colours do not fade.

Bead work when used as a trimming, as shown in Fig. 6, is made of fine beads, generally black, all of the same size. The only foundation required is a narrow strip of braid upon each side. String twenty-two beads for the first row, and commence the pattern by putting a needle and thread, on which five beads have been strung, through every sixth bead.

Bead Mosaic Work consists in uniting together beads without any foundation. The beads used are long transparent ones variously coloured, which are formed by this process into hanging baskets, lamp shades, etc. Thread the beads upon linen thread in order as to colour and pattern of the first row; in the next and in all other rows, thread each bead singly, and pass the thread through the bead above and beyond it in the preceding row. No bead can be placed under this threaded one, so that only half the number of beads are used in the rows after the first one, and the work presents a battlemented appearance while in progress. Always commence the work in the centre of the pattern, whether the design is round or square, and, one side finished, return to the middle, and from there work the other. The designs are all geometrical.

Beading on Cloth Materials.—A simple design for beading on velvet, cashmere, or some similar material is shown in Fig. 7. With care it may be worked without the trouble of transferring the pattern to the material. A straight line ruled with chalk is all that is needed, the beads are sewn on in sets of three, those lying straight along the line being put on first, and the slanting lines afterwards.

Millinery Sprays.—Threaded on wire, beads can be used very effectively for sprays for millinery, mixed with loops of ribbon in the front of a hat or bonnet. A spray of this sort (Fig. 8), in two colours or shades, can be made in the following way. Take a piece of wire about 20 in. long, thread on it thirty beads, alternately one of each colour. Put the two ends of the wire together, keeping the beads round the loop at the other end, twist this loop three or four times so as to make a stalk. Then putting about twenty-four beads on each side wire, twist in the same way. Before making the next two loops, twist the wires together for a few turns to form a stem.

Bead Work Trimmings.—Bead work on net is largely used for trimmings, and looks well executed in white or black bugles, as well as with fine beads of any colour. Mark the design out on a strip of stiff glazed calico or cartridge paper, and tack net the colour of the beads over it. Thread the beads singly upon fine sewing silk, and sew them on the net so as to fill

Fig. 18

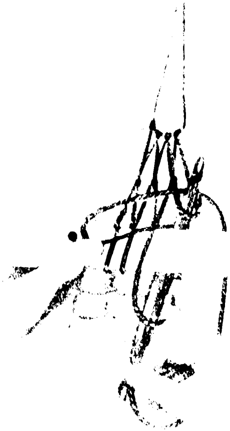
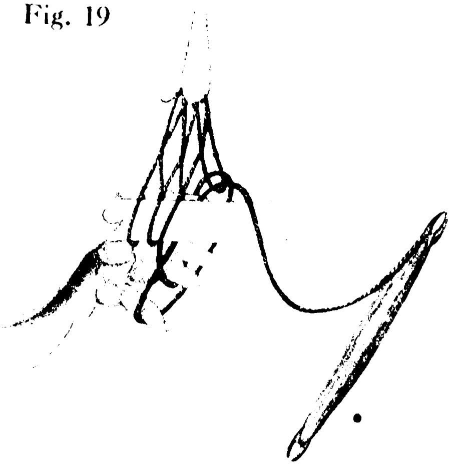


Fig. 19



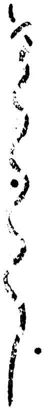


Fig. 24

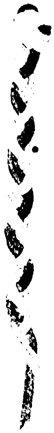


Fig. 25

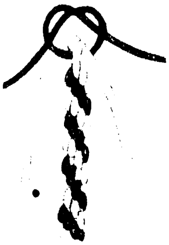


Fig. 26

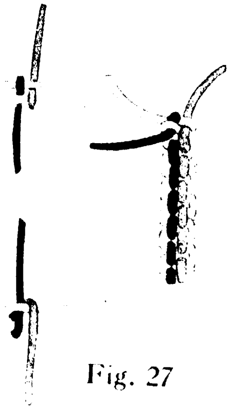


Fig. 27

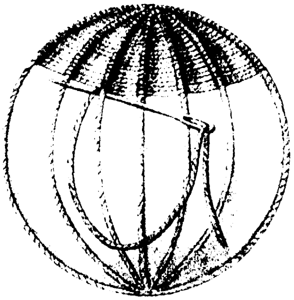


Fig. 17

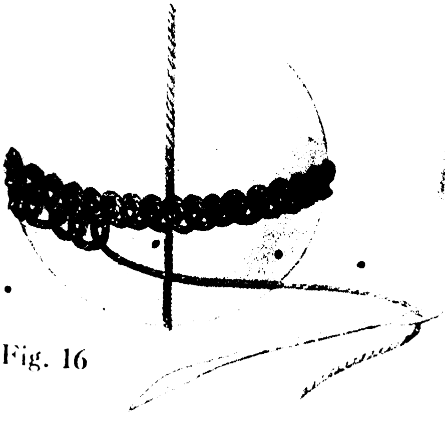


Fig. 16

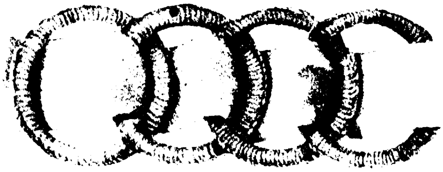


Fig. 10

NETTING. CORD PLAITING. BALL COVERING. A STRING OF COVERED RINGS

S.H.

the pattern under the net. When finished, take the net off the pattern.

Method.—In teaching bead and string work to a class of young children, it is well to vary the methods used, so as to bring out the different capabilities of the pupils. The method of discovery, based as it is on the real meaning of the word education, stands undoubtedly first. The child's reasoning and imaginative powers are called into play, and he learns to express himself. All means of self-expression tend to clearness of thought, as the child sees outside himself, in definite form, the result of what may have been a rather indefinite mental picture. The children may be shown a simple finished article, such as a string of beads, arranged in some particular manner as to number and colour, and asked to see who can produce one just like it. In learning to knot string, this method is not quite so easily applied, and it will often be found necessary for the teacher to have a coarser kind of cord for demonstrating to the class. The children can then follow the actions as they are done. An interesting and useful competition game can be occasionally played by letting the children work together from the dictation of the teacher, thus training them to work from verbal instructions; and then to compare the results at the end. Done under time-varying limits, this gives a good test of complex mechanical accuracy.

Covering with Twine.—Fine, coloured macramé twine may be used as a covering for rings, either bone or brass (the latter are stronger), and these can be made up into various useful articles. The method of covering is shown in Fig. 9. In the figure the loops are shown separately, but they should, of course, be pushed tightly together so as not to show the ring at all.

To cover these rings thoroughly and evenly forms a convenient finger-training employment for children of about six to eight years. The necessary material is inexpensive, and the single looping of the twine being mastered, the pupils do not require constant assistance from the teacher, as is the case with a good deal of handwork for young children. They will probably need help at first with starting a new ring and finishing off neatly.

The rings may vary in size, those from about ¾ in. to 1 in. in diameter being the most convenient, and when they are covered, they may be made up in various ways. Threaded on ribbon or braid, as in Fig. 10, they will make into pretty serviette rings or curtain chains. They can also be sewn into sets of dinner mats. Fig. 11 shows one way of arranging these. For this purpose it is well to be careful about the colours of the twine, as some of the brighter ones would be liable to cause stains if any liquid were spilled on them.

The buttonhole rings are improved by filling in the centres. When the ring is fully buttonholed, pass the string through the edge of the first stitch and make the ring complete. A bodkin or bast needle can be used. Pass the string across to the other side of the ring under two stitches, and cross over and return. There will be three strings tightened across the centre of the ring, widening towards the lower side. With the same string weave to and fro until the centre is filled (Fig. 12).

Mats and various small articles can be made by buttonhole work on either wire or cane frames, or on cardboard moulds which can be bought for the purpose. A rather quicker way of covering these frames, when a large quantity is required, is with a crotchet hook. This is done by drawing a loop under the frame, or through the ring, from back to front, and then pulling the twine through both loops (Fig. 13).

THICKER TWINE WORK

Weaving on Cardboard.—Passing on to the thicker macramé twine, one of the simpler ways of using it is the weaving of twine on cardboard foundations. The warp should be of rather thicker twine than the woof, and as it is scarcely visible in the finished work (showing only in the centre of a disk), the colour is not very important. A long, strong packing or bast needle is the best implement to use for the weaving. The twine cannot be used in great lengths, but, if firmly tucked in at the back, the starting of a fresh piece is imperceptible. Disks and cylinders covered in this way make up into pretty little boxes, which can be fastened with a button mould covered with twine, and a buttonholed loop, or two loops.

The cardboard disks and cylinders can be obtained from any good firm supplying school stationery and requisites. They can also, of course, be made by hand at home, but the bought ones will be found more satisfactory, and will save much labour.

The same work is often done with a woof of bast, but twine is a more uniform material, and will give a wider range of colours. Fig. 14 shows the method of stringing and covering the disks and cylinders, and also an example of a finished article.

It is necessary to have an uneven number of holes in the disks and cylinders, to make the weaving come on alternate strands. This has been found a suitable occupation for boys and girls of seven and eight years.

There is another method of covering these disks and cylinders with twine, which does not necessitate an uneven number of strands threaded on the cardboard. Instead of weaving over one and under one as in ordinary basket work, you pass the needle under one of the cords and then back over it and under again. This forms a firm rib, and quite covers the foundation strings. It takes longer than the other method, but produces a rather more finished article (Fig. 15). The edges should be finished off with a flat plait of string, which can be sewn on through the original holes.

Covering Balls.—String makes an excellent covering for home-made balls, and a class of boys will get very keen on the making and covering of balls for their own use. A good foundation for a ball of this kind is a lump of cork roughly rounded and covered with rag. To secure a good shape and a fair amount of resiliency, it is well to wind this tightly over with wool (very thin strips of old woollen rags will serve the purpose, though not quite as well). This may then be covered by having the hand portion of an old leather glove sewn compactly over it.

To cover with string, it is necessary to tie at least two, and preferably three, circles of string round the ball, and then proceed as shown in Fig. 16. It is the same method as that used in covering a ship's fender. It will be necessary to lessen the number of stitches at regular intervals, as the circles get smaller. An ordinary packing-needle is the best implement to use for this work, though I have known boys do it entirely with their fingers, and use pieces of string diligently collected and knotted together.

These string-covered balls afford an excellent grip, and can be used for various boys' games. The cover can be renewed as soon as it is worn.

Softer balls for young children's use can be covered in the same way as the disks and cylinders. This is done by fastening about eight strands of string right round the ball like meridians. These must be sewn with a few stitches where the strands cross, and they can then be worked with twine, by putting the needle under each strand, and then back and under again. Work round and round in this way till the whole is covered (Fig. 17).

Netting.—Another use for this type of string is Netting. This requires a large wooden netting needle, and a round or flat mesh. A long stirrup of string to pass under the foot is the best plan of holding the work firm, and this forms a foundation which can be easily drawn out when the work is finished. Having filled the needle with string, tie the end to the string of the stirrup, then take your mesh in your left hand, and hold it firmly under the string, close up to the knot just tied; bring the string across the front of the left hand, and back under the second and third fingers and mesh, and hold it between the thumb and first finger. Then bring the thread loosely back under the mesh, and all the fingers, and pass the needle up through the loop held by the second and third fingers, between the mesh and first finger, under the stirrup-loop, and over the thread held by the thumb (see Fig. 18).

Holding the mesh in the same position, draw the needle through, and pull tightly, holding a loop with the little finger (see Fig. 19). Continue pulling, and let go first the loop held by the thumb, then the loop round the second and third fingers, and then to make a good stitch draw the string tightly across the mesh by pulling the loop round the little finger, and when quite close, release that loop also. Repeat this till you have the required number of stitches.

If the mesh will not hold them all, drop some off the left-hand side. Turn the work over, as netting is always done from left to right, and place the mesh close to the edge of the row of loops, and work another row, taking up each loop of the last row. The needle can be filled when necessary and joined with a knot, but

Fig. 11

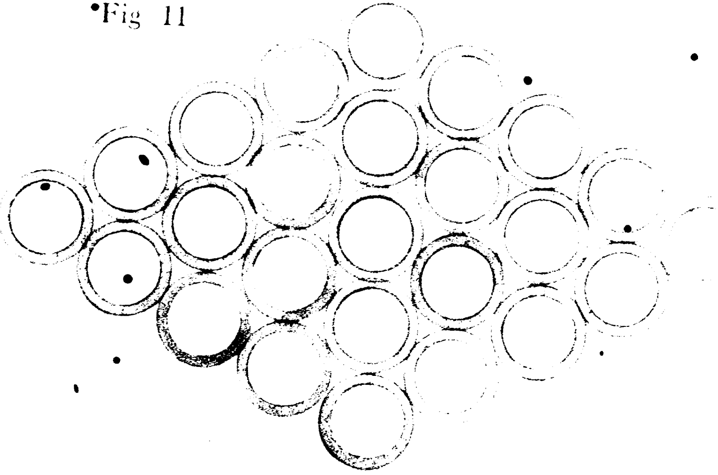


Fig. 15

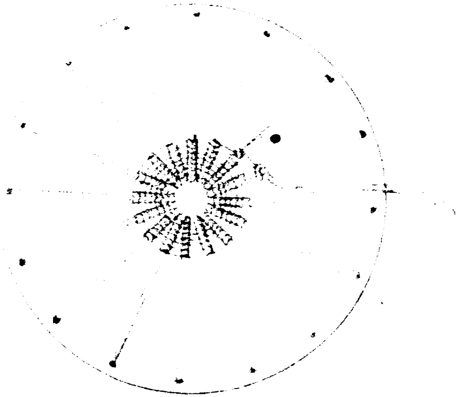
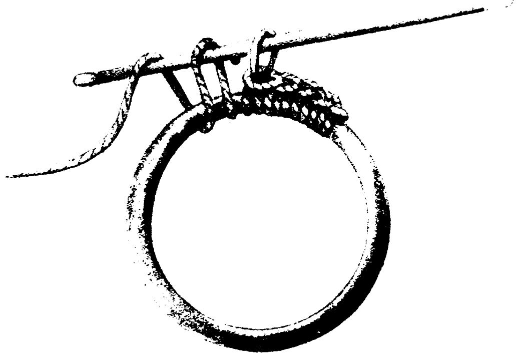


Fig. 13



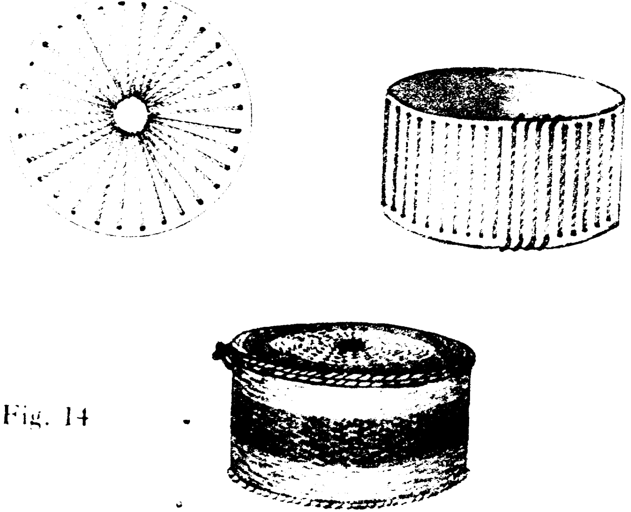


Fig. 14

METHOD OF COVERING RINGS AND DESIGN FOR MAT   COVERING DISKS AND CYLINDERS FOR CIRCULAR BOX

these joinings are best kept at the edge of the work. Rows of the same length will form simple diamonds.

If square netting is wanted, the work is begun at one corner by setting on two stitches only and working two stitches in the last loop of each row. When the diagonal of your square is large enough, do one row without increase, and then decrease by taking two stitches together at the end of each row, till only two remain. You can join these by knotting the end of the string at the top of them.

To do an oblong piece of work with square holes, begin as for a square, and when the work is wide enough, increase a stitch at the end of one row, and decrease a stitch at the end of the other row. It is well to mark one side by tying something on, so that no mistake may be made. The first-mentioned and simplest type of netting is useful for making garden-hammocks and useful parcel bags. The square-hole netting will make lawn-tennis nets and fruit nets.

Netting can be taught to a class of boys or girls, but it will be found that some little practice is needed before they master the stitch thoroughly and learn to keep the loops of a perfectly even size.

Knitting.—Knitting string is easier, and often more conveniently managed, than netting. It requires rather less in the way of implements, and is certainly more suitable for younger children than netting.

As knitting is such a usual accomplishment, taught almost invariably to girls, and now increasingly to boys also, it is not necessary to enter here into a full description of the two simple knitting stitches, commonly called "plain" and "purl."

String knitting should be done in coloured macramé twine, which can be obtained in various thicknesses. The work should be kept loose, as the string, not having the elasticity of wool, is not quite so easily manipulated, especially if allowed to become tight.

This work can be employed for a variety of articles, such as mats, bags, etc. A strip of perfectly plain knitting, such as quite a young child could do, worked in stripes of contrasting colours, and folded over and joined up the two edges, will make a useful hand-bag, and only requires two looped handles to finish it off.

Crotcheting.—Crotcheting string is perhaps a little simpler than knitting, and some children learn it more easily. There is not the same trouble with dropped stitches, and the only implement necessary is a crotchet hook of wood, steel, or bone. This work is often spoken of as "crotchet macramé." It is very strong and lasting, and can be used for mantel-borders, bags, tidies, flower-pot covers, etc.

A very strong bag for shopping purposes or carrying books can be made as follows: Make a long row of chain stitch of sufficient length for the bottom of the bag, and then work round and round it, either with double or treble crotchet stitch. If preferred in a more open-work style, crotchet one or two chain between each, omitting the same number of stitches on the row you are working on. A fancy border on top makes a good finish. The pair of handles may be made with double crotchet along a row of chain stitch, and sewed to the bag with fine string. These bags, especially if made solidly, that is, without holes, look very nice varnished, or stained and varnished, and keep fresh and clean much longer. The same may be said of the knitted string work.

Hairpin crotchet work is a branch of crotchet suitable for fine string work. It is done with a bent wire and a crotchet hook (Fig. 20). Having made an ordinary loop with the hook, put it on the left prong of the fork, and holding the fork with the bend at the top and the thread in front, put the thread round the right prong and back over the fingers of the left hand, as in ordinary crotchet. Put the hook through the first loop and pull the thread through, and then through that again. The work is now fairly started. Take the needle out of the loop, turn the fork gently over to the left, put the hook into the loop and pull the thread through the loop on the left prong; then draw the thread through both loops. Turn the fork again and proceed as before. As the work increases in length, it will slide off the bottom of the fork.

Long strips made in this way can be joined together with the fingers or a crotchet hook by pulling the first loop of one strip through the first loop of the second strip, and then the second loop of the first strip through that one, and so on (Fig. 21). The last loop should be firmly tied.

Simple knotting, leading up to macramé work, is suitable for children from six to nine years, and it will usually be found that they take great interest in it. If a large class is to be taught, the teacher should have some thicker cord for demonstrating to the class. The string should be soft and pliable. The best for ordinary use is the coarse macramé, which can be obtained in a variety of colours. Each knot should be finished firmly and evenly before the next is worked.

A good exercise for a first lesson is to give one yard of string to each child. This will give opportunity for calling attention to the length of the yard, and by folding the string in three the length of the foot also. Let the children divide the string in half and then tie a single over-hand knot (Fig. 39) in the centre. From this centre knot let the children make knots along the string towards each end at even distances of about 1 in. They should, of course, have a ruler marked in inches, or a gauge of some sort to measure from. This will impress the size of an inch on their minds, and will be good practice for their fingers in making the knots. This exercise can be varied by making double knots instead of single ones, that tying two single over-hand knots close together. These strings can be threaded with beads above each knot (Fig. 22). Beaded cords like these can be made up into window-blinds, curtains, or cornices, and are very effective made with transparent glass beads of different colours.

Having made knots in a single string, the children proceed to knotting double strings—that is, two strings held together and treated as one. This lends itself to a variety of uses, having much the effect of ordinary netting. Very useful bags for holding parcels can be made by this method (Fig. 23). Three strings of about a yard and a half in length must be passed through a ring, either bone or brass will do, and then knotted into a loop.

The rings should then be threaded on two sticks the required size of the bag, and these two sticks tied together at the ends. A circle of cane or wire will serve the same purpose. Each string is then knotted with the one next it, and in the next row no string must be knotted with the same string as before. For the sake of clearness, only one side is shown in the figure. When the bag is of sufficient depth, knot four strings together tightly and fray out the ends to form tassels. The handles may be made of similar twine, plaited or corded as described farther on, and threaded through the rings.

Plait and cord making, with twine, is an occupation closely allied to knotting. Even the simple plait of three strings (Fig. 24) requires some practice before a young child can keep it nicely even. This exercise may be followed by the making of a broader plait by using two strands together (Fig. 25). These should be kept quite flat. Such plaits are useful in finishing off the boxes made with disks and cylinders, as they form a firm, neat edge.

A good spiral cord in two colours can be made by laying one string across another at right angles, and then tying two opposite ends together alternately with a single-tie knot, each exactly above the last (Fig. 26). Strong reins for children to play at horses with may be made in this manner.

A squarer type of cord is made with four strands. The method is shown in Fig. 27. Each of the four strands is laid back upon itself, and the loops must be kept loose till the fourth strand is passed through the first loop, after which all must be pulled tight. This cord is very suitable for watch guards, when made with fine black braid. This material makes the cord quite square.

Both the foregoing are taught to young children most easily by using twine of different colours. This makes the identification of each strand very simple.

These cords can be used in various ways, such as handles of bags, curtain cords, watch chains, and toy whips. They can be made into strong circular or oval mats by sewing the cord in spiral fashion on a piece of cardboard. This can be finished off with a looped fringe, or an edge of plaited string, and paper neatly gummed over the back to hide the stitches.

MACRAMÉ WORK

Its Nature and Method.—Macramé work, in which all manipulation is done entirely by the fingers, is the next branch of string work for us to consider.

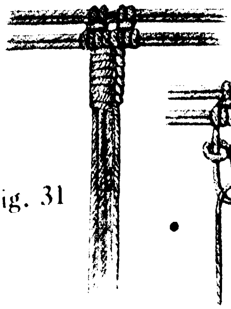


Fig. 31

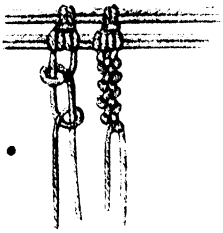


Fig. 30

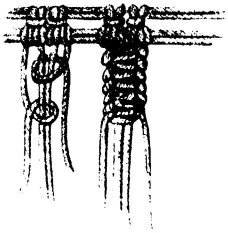


Fig. 32

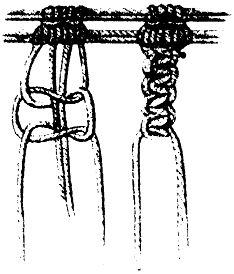


Fig. 33

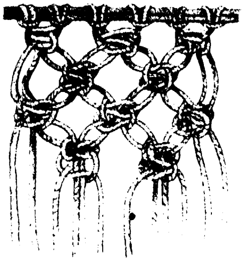


Fig. 37

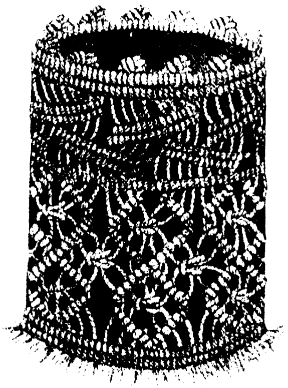


Fig. 35

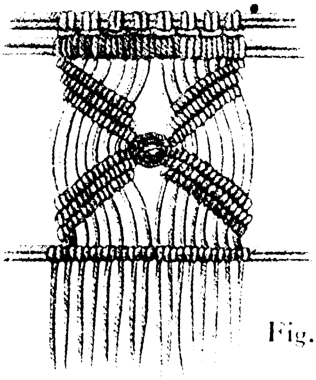


Fig. 34

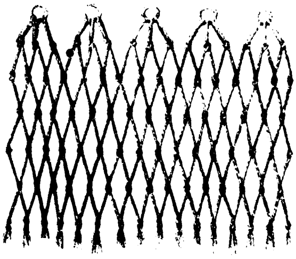


Fig. 23

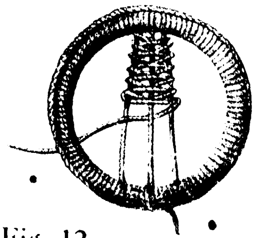


Fig. 12

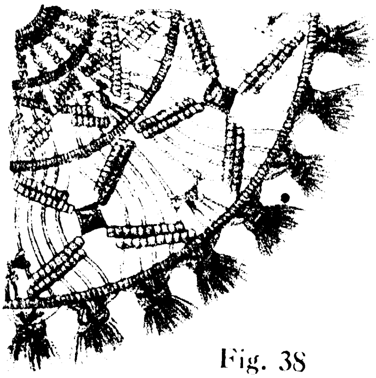


Fig. 38

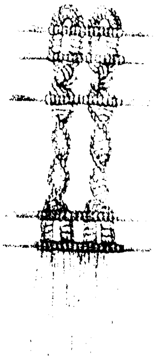


Fig. 36

MACRAMÉ KNOTS AND DESIGNS, KNOTTED BAG AND FILLED RING

This work dates back to the sixteenth century, when it was used in Italy. It is sometimes called " Knotting," a very appropriate name, as it consists of a series of different knots combined so as to form designs. It is very strong, and almost everlasting, but it has the drawback, when used for such things as bracket-drapes or mantel-borders, of accumulating dust. This work can also be done in linen thread, crotchet cotton, or silk twist, and is used for ornamenting household linen and making trimmings.

A frame for holding the work is necessary. One of the simplest consists of a wooden board about 20 in. by 8 in., with a strip of wood nailed on either end to raise the threads a little above the surface of the board. A crotchet hook is very convenient for use where fingers cannot go, also a supply of glass-headed steel pins or drawing-pins to hold down threads. The beauty of the work depends almost entirely in the evenness of every knot made.

A very simple frame can be made from an old slate-frame by boring holes about an inch apart round the sides. The foundation cords can be tightly strung through these holes, and by stringing the whole frame the cords may be used for practising the different bars on. The children might each fill the frame in this manner, as it will be easier for them to work the bars at first with the centre strings securely fixed. Very good boards can be bought for about half a crown, provided with wires for fixing the foundation cords to, and a contrivance for tightening them when necessary.

It has been said that it is impossible to teach macramé work to a large class, but this has been proved to be a mistaken idea, as the work has been successfully carried out in classes of over thirty young children, who have learned a number of the exercises and to copy patterns illustrated on the blackboard. It will be found best to try to keep large classes as far as possible at the same stage, either by letting the more proficient pupils assist the backward ones, or by their doing a larger amount of one pattern. The children should be provided with bags to keep their work in, both for the sake of keeping it clean and also to prevent the entanglement of the threads.

The Macramé Knot.—The work is done from left to right, and is begun upon foundation cords stretched lengthwise across the boards. The first foundation cord is only used to fasten the threads on, the others are always covered with macramé knots. A beginner needs to practise the various knots and bars, and simple stars, etc., before beginning any large pattern, as it is not easy to get the necessary regularity at first. This is not suitable work for young children, but is much enjoyed by older ones, and appeals strongly to boys. Having fixed your foundation cords, which must be double and tight, and with some waste allowed at the end, the first one about an inch from the top of the board, you are ready to put on your working threads. Fig. 28 shows two ways of doing this. The knot must be pulled tight, being shown loosely in the figure for clearness. Fig. 29 shows the macramé knot on the second foundation cord. This forms a fine, strong, beaded ridge. The following figures show some of the simpler bars that can be made. Many of these can be varied by being done with double instead of single thread.

The Single or Double-knotted Bar is very effective (Fig. 30): Having done the macramé knots, hold the 1st thread straight down the board with the left hand, take the 2nd thread and put it over the 1st, then under and up through the loop; hold the 2nd thread in the left hand, take the 1st thread in the right, put it over the 2nd, then under and up through the loop. Continue this with alternate threads. Fig. 31 shows a buttonhole bar made with 4 working threads, the 4th being much the longest. Hold threads 1, 2, and 3 tightly down and pass the 4th over, under, and up through the loop formed by itself.

The Single Genoese Bar is shown in Fig. 32, worked with 4 threads, the two centre ones being held straight, and knots being made with 1 and 4 alternately.

Solomon's Bar (see Fig. 33) is one of the most used. It requires 4 threads, the knots being done by the 1st and the 4th. The 1st thread is put behind and the 4th in front of threads 2 and 3, and each is passed through the loop formed by the other, the front thread (4th) going downwards and the back thread (1st) coming upwards. The next stitch, which is really the completion of the 1st, is the same reversed, the right-hand thread (which is now the 1st) going under, and the left-hand thread going over threads 2 and 3.

A Star with a Knot in the Centre (Fig. 34) is formed by making a bar and curling it over backwards, then working the threads in again to the lower part of the star. The star is made as follows: Eight double threads must be put on the 2 foundation cords at the top in the usual way, making 16 strands. Take the 1st thread on the left, and slant it to the right, fixing it with a drawing or other pin. Work macramé knots on it with the next strings as far as the 8th inclusive. Then take the 2nd string (now the 1st) and slant it along underneath, and make macramé knots with strings 3rd to 8th and 1st. Repeat this once more on the 3rd string. This forms one point of the star. For the next point take the 16th string and slant to the left, and proceed as before, but in the opposite direction, that is towards the left.

Now, using the 4 centre strings, make a Genoese, or Solomon's, bar, with about 6 stitches each side; then turn the two middle strings over the top between the two points of the star, and tie each to its own working string. To finish the star, take the 8th string as leader, and slant it to the left, making macramé knots on it, and do the same with the 7th and 6th. Next take the 9th string and slant to the right, and proceed in the same way. These stars are nicely finished off with a third foundation cord with macramé knots all along.

It will be found that some of the threads, on account of their being used so much more frequently, use up very quickly. A little experience will soon teach the pupil how to allow for this. In any case, it is well to cut the threads for the first part of a consecutive pattern rather too long than too short, as it is extremely difficult to make a satisfactory join.

A Toilet-table Tidy (Fig. 35)—which may be used as a cover to a cardboard foundation or a glass or china one—is an example of the way in which macramé work may be used to make useful articles. Take 96 strings, 1½ yards long. Take each 2 together and knot them in the middle to form an ornamental edge, then work them with macramé knots on 2 sets of foundation cords. Then to make a "leaf," take the 8th string in the left hand and slant to the left, work knots on it with the 7th, 6th, 5th, 4th, 3rd, 2nd, and 1st strings. Take 7th string and slope to left and work knots on it with 6th, 5th, 4th, 3rd, 2nd, 1st, and 8th strings. Do the same with every set of eight strings. Begin at the left again and turn the 5th string slanting to the right, and work macramé knots with 6th, 7th, and 8th strings, also with first 4 strings of the next group of 8. Do another row under this on the 6th string, and then repeat all along.

When this is done, knot on to another foundation cord and work each 8 into bars with two diamonds formed by macramé knots with a Solomon's knot in the centre of each diamond, and also in the spaces between the diamonds. Finish with 2 foundation cords and a fringe of about an inch frayed out. When joined, the pattern can be finished across the join.

A Handkerchief Sachet is another good example. This will require about two balls of twine. Take a foundation cord 30 in. long, and knot on it in the usual manner (Fig. 28) 24 strings, 2½ yards long. This will give 48 working strings. With every 4 strings make bars of Solomon's knots, 2 stitches in a bar. There will be 12 bars in a row. Then leaving the first 2 strings, take the next 4, and so on, making 11 bars in the row. Work these 2 rows alternately till a square is formed. Then knot 24 strings on each side of the square and along the top, where they must be put in between the original strings. Pass the foundation cord round the square, working all the strings on it with macramé knots. Do this a second time to form a firm edge, and put on 2 extra strings at each corner.

Do not use these strings to begin with, but with the 48 strings on each side make a pattern of diamonds, 6 in the 1st row, 5 in the 2nd, and so on till you have only 1. Each diamond has a Solomon's knot in the centre, as in the tidy. Then take the 2 strings at each side of the triangle and bring them down each side like foundation cords, knotting all strings on them to make a strong double edge. Cut the ends to about an inch, and fray out to make a fringe. The finished work should be lined with some contrasting colour.

A Fringe with Buttonholed Top (Fig. 36).—Five foundation cords are needed and strings of 1½ yard in length. Buttonhole a few stitches in the middle of each cord and make a loop as shown in the figure before knotting on to the 1st foundation cord. The twisted banister bars between the 3rd and 4th foundation cords are worked with the 2 outside threads, the 2 centre ones forming a foundation. Lay the left string across 2 centre strings at right angles and under the right string. Turn the right string up behind the 2 centre strings and through the loop formed by the left string. The twist develops naturally, but can be made even by putting the left string at regular intervals under the centre strings instead of over them. The rest of the detail can be copied from the figure.

The Open Knotting (Fig. 37) is useful for covering large spaces, or forming a kind of background for a large pattern. The strings are used in fours, and the centres are made by working a Solomon's knot one and a half times with each set of strings. In each alternate row use 2 strings of the first knot with 2 of the second. Large pieces of work can be done with this pattern, and made up, with or without fringes, into all kinds of articles.

A Circular Mat (Fig. 38).—To make circular articles, a metal ring forms the best foundation, and when the outer circles are too large for this, wire, cane, or string can be used. The advantage of wire or cane over string for this purpose is that it is much easier to keep the work true. It is necessary to cast on extra working strings as the work gets farther from the centre, and in the mat shown in the figure this is done on the cane ring, 3rd from the centre, between every 4 stitches, and again before the 4th and 6th rings by looping the extra threads into the sides of the stars as shown.

KNOTTING

Its Practical Value.—Lieutenant-General Sir Robert Baden-Powell, in his book for Boy Scouts, tells that when in command of a large force of native scouts in South Africa engaged in pioneer work, he found that out of a thousand men, except one company of about sixty, none knew how to make knots, even bad knots, and for that reason were quite useless in the work of constructing timber bridges, though about two hundred had to be built.

But it is not only in pioneer work that a knowledge of the commoner knots and their uses forms a valuable asset. In ordinary every-day life it is surprising how useful such a knowledge is and how, opportunities arise to practise it. Many badly-tied parcels go astray in the post for want of just this knowledge, the string with label attached becoming separated from the parcel. Accidents often occur just because some one did not know how to fasten a rope securely.

A little of the knowledge of knots is certainly of considerable practical value. It may seem to some that it is too trivial a matter to trouble about, and will be easily picked up without any special instruction. There is no doubt that a boy, or girl for that matter, will often take a little trouble to acquire this knowledge, but one has only to question a large group of boys, say from eleven to thirteen years of age, and, unless they belong to the Scouts, it will probably be found that they are quite ignorant of any type of special knot. In addition to this, it is not quite the simple matter it would seem to be to instruct them. It is wonderful how soon a class will divide itself into two groups, consisting of the more and the less intelligent members, over such a simple matter as the tying of a reef knot. An appreciation of form is, of course, a great help, but a boy who was an excellent draughtsman has been known to take two half-hour lessons to learn the reef knot.

Knots, Bends, Hitches, Splices, and Seizings.—These are all ways of fastening cords or ropes, either to some other object, such as a spar or ring, or to one another.

The Knot (from the same root as *knit*) is formed to make a knob on a rope, generally at the end, and by untwisting the strands at the end and weaving them together. But it may also be made by turning the rope on itself.

A Bend (from the same root as *bind*) and a *Hitch* are ways of fastening or tying ropes together or round spars.

A Splice (from the same root as *split*) is made by untwisting two ends and weaving them together.

A Seizing (from the French *saisir*) is made by fastening two spars to one another, or two ropes by a third, or by using one rope to make a loop on another.

But these expressions are often used interchangeably. Speaking generally, a knot and seizing are meant to be permanent, and need to be unwoven to be unfastened, while a bend and a

Fig. 1

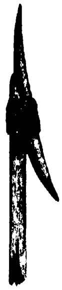


Fig. 9

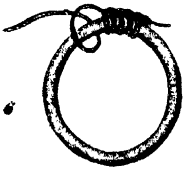


Fig. 20

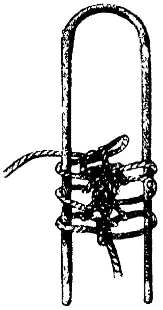


Fig. 21

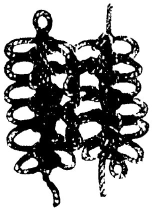
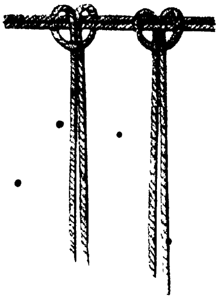
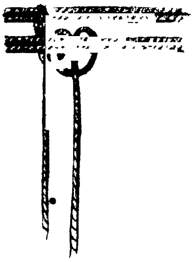


Fig. 28



Method of putting strings on cords

Fig. 29



Macrame Knot

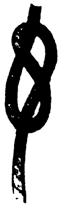


Fig. 40

Figure of eight

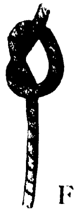
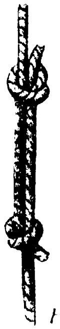


Fig. 39

Overhand Knot

Fig. 46



Fisherman's Knot

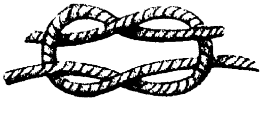


Fig. 41 *Granny Knot*

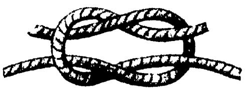
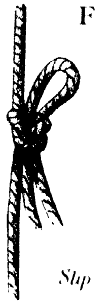


Fig. 42 *Reef Knot*

Fig. 45



Slip Knot

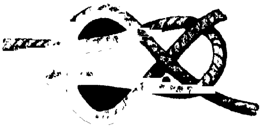


Fig. 43

Sheet Bend

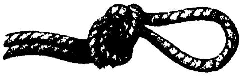


Fig. 44

Overhand Loop

ANCIENT ARROW-HEAD TIED ON WITH STRING. HAIRPIN WORK. KNOTS

hitch can be undone at once by pulling the ropes in the opposite direction from that in which they are meant to hold. Yet the reef knot can be undone with ease.

The various kinds of fastenings are employed in different industries, as, for example, weaving, scaffolding, military construction, as well as seamanship.

The governing principle of these fastenings is that the strain which pulls against them shall draw them tighter.

The following are some of the more important knots, etc., with their special uses. The figures will mostly supply sufficient directions for tying them.

The Overhand Knot is the first and simplest knot (Fig. 39). This is used at the end of twine and ropes to prevent their untwisting, and is made by taking one end round the other. Another knot used for the same purpose is the "Figure of Eight" (Fig. 40). It forms a rather larger knob than the last.

The Granny Knot is the first of the double knots (Fig. 41). This really is the only knot most people can tie, and also the only one that children learn to do. It is a bad knot, for it slips away when a hard pull comes on it, or else gets jammed so tightly that you cannot untie it. Though so commonly used, it is best to keep clear of it altogether, as it is not satisfactory for any purpose.

The Reef Knot (Fig. 42).—This is one of the most useful and universal knots known. It is more sightly than the granny, and forms a nice flat knot. For this reason it is almost the only knot used in ambulance work. Tourniquets and triangular bandages are always fastened by such a knot. It may be used for joining string of all sorts, and ropes. It will not slip (unless possibly with ropes of extremely different thicknesses), and it is very easy to untie, which may always be done by pushing the two bights or loops in different directions. For children it is a useful knot for bootlaces. It is also safe for tying up parcels. The two ends at one side must both go either down or up through the loop. The habit of always tying a knot in this way, without having to watch your ends, is soon acquired.

The Sheet Bend (Fig. 43) will come in rather appropriately here, as it is useful under circumstances where a reef knot might possibly fail. It is used to join string or rope of different thicknesses, which will then be quite safe from slipping. Make a loop with one rope, and pass the end of the other up through the loop, and put the end under its own standing part. This is also called the *Weavers' Knot*, being the one commonly used for joining broken threads in a loom.

The Overhand Loop (Fig. 44) is self-explanatory.

The Slip Knot (Fig. 45), which may be instantly unfastened (not the running noose that is usually understood by the term), can be made by first tying a reef knot, and then putting one of the ends back through the bight, and leaving a loop. This will give a sure hold, but can be instantaneously released by pulling the end forming the loop, as in an ordinary bow.

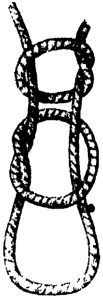
The Fisherman's Knot (Fig. 46) is made by laying the ends of two pieces of string or rope alongside each other in opposite directions, and making with the end of each a single overhand knot round the other. These two knots will then run close up to each other, and can be undone by the ends simply being pulled apart. It is often used for joining fishing-lines, and may also be used to join lines or ropes of different thicknesses.

The Middleman's Knot (Fig. 47) is made in a similar manner to the last, but with one piece of cord only, folded back in a loop upon itself. This loop will not slip when the knots are drawn together, and is often used to make a halter.

The Bowline Loop (Fig. 48) is another very useful loop that will not slip, and is the one in most frequent use. Make a twist or bight in the standing end of your rope, pass the end up through this, round the standing part, and down again through the bight. This loop is the one generally used to put round a person being lowered from a building or drawn up from below.

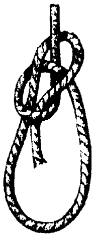
The Bowline on a Bight (Fig. 49) is made similarly to the last, but with the doubled end of the rope, and the standing and other ends are then passed through the loop formed by the doubling back of the rope. This is used for the same purpose as the last, and makes a more comfortable sling for a man than the single bowline, but takes rather more rope. Running bowlines are formed by making a bowline round its own standing

Fig. 47



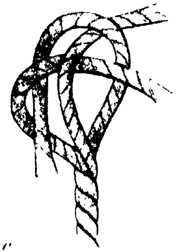
Middleman's Knot

Fig. 48



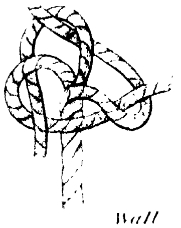
Bowline

Fig. 55



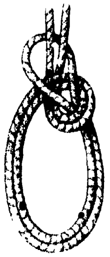
Crown

Fig. 56



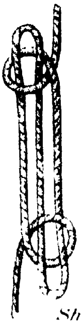
Wall

Fig. 49

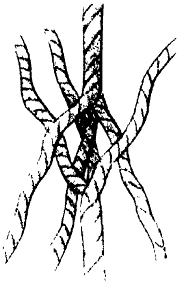


Bowline on a Bight

Fig. 50



Sheepshank



Short Splice

Fig. 57

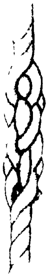
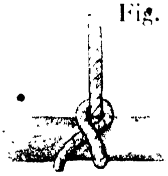
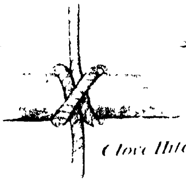


Fig. 51



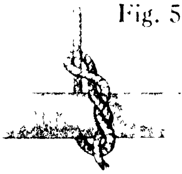
Half Hitch

Fig. 52



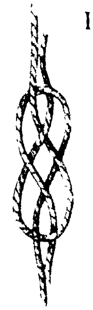
Clove Hitch

Fig. 53



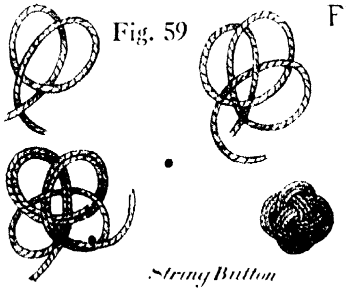
Timber Hitch

Fig. 54



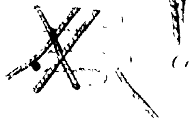
Carrick Bend

Fig. 59



String Button

Fig. 61



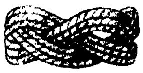


Fig. 60

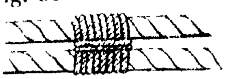


Fig. 58

Flat Seizing

KNOTS, SPLICES, HITCHES, CONTINUOUS PLAIT, STRING BUTTON

part. These are the most common and convenient temporary running nooses.

The Sheep Shank (Fig. 50) is used for shortening cords such as tent ropes, etc. Gather up the amount to be shortened into a loop pulled long, then with the two standing parts make a half-hitch round each end of the loop. This brings us to the hitches.

The Half-hitch (Fig. 51) is made by passing the end of a rope which is round a spar round the standing part and through the bight. Two half-hitches, or a *Double Hitch*, are commonly used for mooring vessels to posts or rings, and are capable of resisting to the full strength of the rope. If the end is bound to the standing part, it is impossible for it to get jammed.

The Clove Hitch (Fig. 52) is very well known, and extremely useful. Pass the end of the rope round a spar or pole, cross it over, pass the end round again, and put it under the crossing piece. The great advantage of this fastening is that it will stand a strain without slipping either lengthways or downwards.

The Timber Hitch (Fig. 53) is made by taking the end of a rope round a spar, then round the standing part, then several times round its own part.

The Carrick Bend (Fig. 54) is a very pretty, symmetrical knot. Carefully drawn on the blackboard, it forms quite an interesting drawing copy. The figure shows the arrangement of the interlacing bights. For practical use the ends should be fastened securely to their own standing parts. This bend is used to unite two hawsers, which will have to run freely through a hole, as connecting them with two bowline knots is a very clumsy way and is liable to jam in passing through a narrow space.

Finishing Knots.—To proceed now to knots for finishing off the ends of ropes. These are made by untwisting the strands at the end. It is very useful to know how to make a neat finish at the end of a piece of rope or cord. If, directly a piece of cord is obtained, the end is neatly finished off with what may be termed an "end splice," though, strictly speaking, it is not a splice at all, waste is prevented. When the end becomes unravelled, many persons cut the frayed part off each time the cord is used, and so it becomes shorter and shorter.

And here it may be worth while to state how this untwisting may be remedied. I remember how it puzzled me as a child to find that when a three-stranded rope became untwisted at the end, and one tried to twist it up again, it would not stay twisted as at first. The solution of this is to twist each strand the reverse way, as one gives it the necessary twist to match the twist of the rope. This simple reverse twist makes all the difference, and gives the strands a grip on each other.

A Crown (Fig. 55).—To make a proper end, it is necessary to begin with what is called a Crown. Untwist about 3 in. of the rope, which is in all probability a three-stranded one, though the same directions will apply equally well to a four-stranded rope. Most hempen ropes are three-stranded, but there is now on the market a quantity of plaited rope, especially in cotton rope, which cannot be manipulated in at all the same manner as the ordinary twisted rope. Turn each of your three ends downwards so as to form an upright loop, and put the end of each through the loop of the next. Pull this evenly till it is quite tight. This forms the "crown," and having made this, all that is needed is to interlace the three strands with the strands in the standing part of the rope, under one and over one is the method. Take each strand in turn and put through under the strand nearest it. Each goes under a different strand. Then over the next, and under the next, and so on.

If the cord or rope is stiff, it will be found necessary to use some sort of tool to hold open the twisted strands while the ends are put through. On board ships a marling-spike is used, but a round piece of wood about 8 or 9 in. long, and 1 to 1½ in. in diameter, tapering to a pointed end, is easily made, and serves all purposes for splicing. This is commonly called a Fid.

A Wall.—To make a thick knot at the end of a piece of rope, you begin with what is called a wall (Fig. 56). This is exactly the reverse of a crown, and is made by turning the three strands upwards and passing each upwards through the loop formed by the next one. Having pulled this tight, you next make a crown, and the two combined form a spherical knot. The size of this may be increased at will by using longer strands, and following them each through the same places as before a second or even a third time. A very heavy knot may thus be formed. These knots are used sometimes to finish off the end of a climbing rope in a gymnasium ; they are also used to make the ends of handles for wooden buckets.

Splicing.—*The Short Splice, or Joining Splice,* is used to join two pieces of rope of about the same thickness, and forms the only neat method of repairing a broken clothes-line or a box-cord. Having untwisted, or "unlaid," 3 or 4 in. of the end of each piece of rope, you fit them into each other somewhat in the manner of dovetails, that is, each strand of each end lies between two strands of the other rope, and the whole is pushed together as closely as possible (Fig. 57A). This is called "marrying" the strands. Then, holding down one set of strands close to the rope they lie along, proceed to plait the other three strands, taking each in turn, under the fixed strands of the firm part of the rope. They must run in a contrary direction to the twist of the rope, and the ends are put through by means of the fid. If each set of strands is put through twice, the join is absolutely secure. A neat tapering finish is made by taking only half a strand for the second or third pulling through. The splice should be well stretched and if necessary hammered into shape, and then the ends of the strands neatly cut off close (Fig. 57B).

The Eye Splice, or Loop Splice, is the next simple one. Its uses are almost too numerous to mention, but it is a neat way of making a loop for a running noose for cording boxes or fastening ropes. It is made by bending the end of the rope round, leaving the loop, of the required size, of firm rope, with a few inches of unlaid strands below. Enter the centre strand under a stand of the fixed rope, and the other two in a similar manner on their respective sides of the first, pass each through again, working, of course, as nearly as possible at right angles to the twist of the rope.

If neatness is desired, halve the strands, and pass through once more, and cut off smooth. If much wear is to come on the loop, as for instance in putting up a swing for children's use, or hanging a trapeze, the eye splice should be done round a piece of metal, shaped to fit it, called a "thimble."

A Flat Seizing is used to lash two parallel ropes together. The size of the seizing-line should be about one-sixth that of the ropes to be joined. An eye is spliced in the end of the seizing-line, and it is rove through and round both ropes. A number of turns are then taken round the two ropes. These may be done slackly at first, and then when the end is pushed down through the turns, the whole may be tightened, or two cross strands may be taken as in Fig. 58, and the end may be pushed up through, and a wall knot made to hold it fast. It is not necessary to mention the many other varieties of seizings, as they are almost entirely connected with nautical work.

How to Finish off Bindings.—It may be useful here to tell how to finish off a binding, such as on a bat or hockey-stick, securely. To do this, bind the last eight or ten rounds over a long separate loop of twine of about the same thickness as the binding twine, the bend of the loop pointing in the direction you are binding, and then put the end of the latter through the loop, pull under the rows of binding, till tight, and cut off close. If required very near the end of a stick, bat, or rope, the binding string can be bound over its own end by putting it over the top at each turn. The end, which must be left long enough below where it enters the binding to allow of a good grip, can then be pulled tightly down and cut off.

String Buttons.—It is useful to know how to make buttons of string or leather boot-laces. The method of doing this is shown in Fig. 59 *a*, *b*, *c*, *d*. The two natural ends left when the button is completed are a convenient means of fastening it on, as each end can be pushed through a separate hole, and the two ends finished with a reef knot at the back. This makes a very good top for a lady's hat-pin, worked with a tan leather boot-lace round the knob of an ordinary glass-headed hat-pin.

Plaits and Rings.—A continuous plait of the same description as the button is sometimes used to make a neat finish to an eye splice. It can also be used to make serviette rings (Fig. 60). The easiest way is to twist the cord round the fingers of the left hand, as shown in Fig. 61. Put the end from right to left under the right-hand string on the back of the hand, pull the left-hand string over the right, and put the end from left to right under what is now the left-hand string, pull the left-hand string back under the right and put the end from right to left under what is now the right-hand string, pull the left-hand string over once more and put the end from left to right under what is now the left-hand string. Take this off the hand, and it will be found that the end will lie alongside the beginning of the plait. Now follow the string round, keeping it lying flat by the other till the plait has as many strands as you require. These rings look well done in stiff coloured blind cord, and they can also be done in cane.

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XLIX. HANDWORK AND SCIENCE

By G. H. Woollatt, Ph.D., F.I.C.

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What to Make, and Why.—The question of how far handwork and science are of mutual service is not an easy one to settle. First there is the obvious trouble that science comes later in school life than handwork, and relies upon handwork training for much of the manipulative skill needed in the making of experiments. Frequently boys who commence science at say thirteen years of age discontinue handwork as a time-table subject, the new work giving all the old training, with much in addition. This is the sequence difficulty.

Next is the fact that to be of any real contribution to the school training the boy who makes the apparatus also should use it. According to our ideals the need and purpose of the apparatus should be clear and definite to the maker, before he begins to construct it—it must be necessary and vital to him personally; he must himself have experienced the need for the apparatus, in order that he may design one which shall circumvent all the troubles he knows will surround its use. This presents to us the skill and the time difficulties, for a boy may be unable to make a piece of apparatus he has come to need, purely through absence of technical skill, and it is often a question whether this technical skill (such as, say, glass-blowing) is worth acquiring for the special purpose. For a teacher it may be, but for the boy the answer is doubtful. Also the science lesson can rarely wait for the expenditure of several "manual" lessons during which a needed piece of apparatus can be constructed.

Lastly, the skilful experimenter is not always a good constructor, and the degree of accuracy needed in modern science apparatus (since most experiments in contemporary science courses lead to numerical results) is frequently far in advance of the capabilities of the boys who are to use this apparatus.

Now I cannot pretend to set the limits between which any teacher may work. It rests with each individual, and his personal assessment of the value of each controlling factor, which track is followed. But, without dogmatising, I may state that my own experience leads me in general:

1. Not to make common laboratory apparatus, such as test-tube stands, for school use, merely because they are simple and reasonable exercises for boys in the woodwork classes. Mending these same articles is a different story. Time, service, skill, attack, all have different values.

2. To discourage the making of apparatus from which quantitative (and comparative) results are sought (apparatus of precision, that is).

3. To confine the making of apparatus to those forms which are near the end of their "manual" and the beginning of their "science" work.

I could wish that space permitted some discussion of these principles. None is rigid, but each is normally defensible, and in general they prevent more misuse of time than they penalise ingenuity. More and more the teacher's business is that of balancing values, and this is the reason for such divergent practice in schools—in itself a healthy condition. Given an experienced teacher, it is no longer possible that a boy should spend a term in making, say, a brass steelyard, while his science is hung up during that time awaiting its completion. Yet I remember such an object securing a first prize at an educational handwork exhibition—completely out-classing many simple and original devices of great merit. The skill required for the production of an accurate quantitative instrument is rarely attainable by boys save at too great a cost educationally, and all the educational value of the said steelyard could have been secured by the making of a wooden one in a single lesson.

These limitations may impose upon the following suggestions the appearance of giving a rough and ready product, and this is to some extent a just criticism. But if one admits that a boy has, as, a rule, no innate sense of great accuracy, and that comes to him only when he has tried and failed with clur tools; also that a boy's own-made science apparatus sho “ arise out of his desires and be subservient to his needs,” much the criticism will be disarmed.

The only point outstanding is the nature of the science teac ing. If this is text-book stuff, taught by a science man w "looks through a text-book and orders the pictures" wh stocking his laboratory, the manual department will be able help but little. If, however, the teaching be of that text-book-le type that we reserve mainly for our middle-school forms (c non-examination forms, where we can spare time to educat instead of inform) much may be done. The boys will usuall take care that neither science nor manual work suffers, as the will complete portions during out-of-school hours.

It is hoped that some of the suggestions outlined below may be of service. The exercises are chosen because the construction illuminates the teaching, because the teaching is done better by the construction of the apparatus than by merely using it. This is not true of all apparatus, particularly the quantitative kind. For example, the making of a spectrometer is within the capabilities of a middle-school boy of fourteen to sixteen years, but it is the work of half a term, during which he is learning nothing new of spectrometers, the principle of which is simple and must be understood before commencing work. When completed, if the accuracy throughout is not of a high order, the instrument is useless. Therefore I decline to allow it to be made, even though no doubt all the boys could make it, and half a dozen of them make it well.

On the other hand, a variable-immersion hydrometer—the making of which, again, is within the powers of the middle school. —is an instrument which is but imperfectly understood at the beginning of its construction, and every successive process makes its working more clear. Even if at the end the boy has made a bad hydrometer, he has still learned the whole story of its action and he values more highly the bought instrument used when great accuracy is required. He *understands* the instrument.

It is such considerations as these that decide when an apparatus may be made and when not, rather than the mere capability of making it; perhaps it is not too much to say that *no apparatus should be made unless in its making there is as much instruction as in its use.*

MECHANICS

Levers.—A satin walnut strip, 18 in. long, shaped as in sketch (Fig. 1) will be found quite suitable for experiments upon moments. The shape gives stiffness, without which the wood frequently becomes twisted when heavy weights are used. (Boys will suggest this shape, if the danger of twisting is apparent to them.)

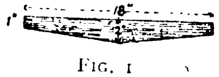

FIG. 1

Experiments upon sensibility and sensitiveness can be made by using a series of holes drilled by means of a hot wire (equally from each side) along the line of greatest depth.

The lever is suspended by passing a knitting needle through one of these holes and supporting its two ends upon blocks or by corks held in retort stand clamps.

If it does not exactly balance, a small lead "rider" made from the lining of a tea-chest is made, and balance is attained by sliding this to the correct position on the lever. Weights may be made from leaden bullets, such as are used to weight fishing-lines. They are fixed upon a thread looped at the top (Fig. 2), so as to slip easily along the lever; they should be tested to make sure that the strings are of proportional weight, and then balances and bought weights (which interfere with the psychology of this experiment) are unnecessary. For the size of lever given above, bullets half an inch in diameter are necessary.

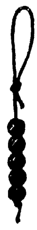

FIG. 2

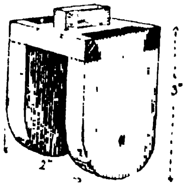

FIG. 3

For experiments upon the second and third order of levers, the same apparatus may be used, though the shape is not so suitable as a thin lath of equal width. If, however, a heavy leaden rider be used, the Danish and the Roman steelyards, together with certain limiting conditions, are easily discovered.

A simple support, which has the additional advantage of encouraging the discovery of "dovetails," may be made as shown in Fig. 3, and this support may be clamped in a retort stand clamp and so provide a simple, accessible, and easily mounted apparatus from which the "balance" may be derived.

Foucault's Pendulum.—The chief value of this instrument is that of showing a relative motion between a fixed vertical plane and the plane in which a pendulum swings, as evidence of the earth's rotation. The chief interest lies in the design of a support which will permit this relative motion without producing a twist in the suspending string. All else matters little. A 7 lb. ring-weight slung upon a piece of the thinnest (because least air-resisting) wire obtainable is all that is necessary. It is obvious that a suspension which is to be identical on all sides must depend upon a point, and this must be hard enough to retain its shape, and must be supported upon an impenetrable surface.

Where a steel H girder crosses the ceiling, all is plain sailing, one has but to clamp or bolt a piece of tool steel 1 in. wide by two G clamps or $\frac{1}{8}$ in. bolts to the girder, and lightly "dot punch" it for the reception of the point of the suspending unit. Conditions will decide the shape of this. The point must be in line with the wire, there must be enough overhang to clear the girder, the wire and the needle-point must be securely clipped, and the weight of the unit must not be greater than is absolutely necessary.

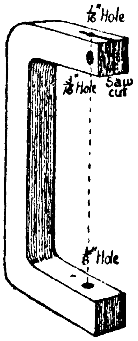

FIG. 4

A piece of wrought iron at least $\frac{3}{8}$ in. square is bent into suitable shape (any physical or chemical laboratory has as part of its equipment a blowpipe sufficiently powerful to allow iron this size to be made red-hot for bending) and drilled as shown in Fig. 4. A saw-cut is made with a hack saw, as shown.

Through the top $\frac{1}{16}$ in. hole a piece of one end of a knitting needle is passed, projecting inwards about $\frac{3}{4}$ in., and a $\frac{1}{8}$ in. bolt, such as is found in "Meccano" sets, is put through the hole at right angles to the needle and tightened by a nut. The pendulum wire is twisted into a loop at the top, threaded through the lower hole, and a piece of the knitting needle slipped through the loop (Fig. 5). The whole is now ready for use. It is well to allow the instrument to remain, erected,

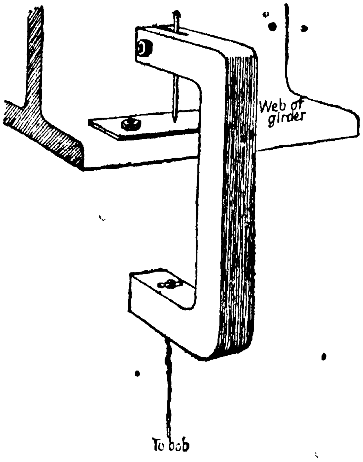

FIG 5

and in position for some hours before use, in order to stretch the wire completely and to allow twists to uncoil.

To start, pull back the bob in a direction at right angles to the girder, for a distance of about 2 yards, and hold it there by means of a cotton thread attached to some firm object. After some minutes when all is quiet, and all tremors out of the wire, make a line on the floor immediately below the path the bob will take when released. Then release the bob by burning the thread. The pendulum should swing for about three hours for the result to be quite convincing. The experiment should be made a quantitative one by measuring time and angle covered at frequent intervals, and constructing a graph by co-ordinating these records. A simple calculation will give the approximate time of rotation of the earth upon its axis and the nearness of the answer to the actual time will be a measure of the suitability and accuracy of the device employed. If there is no steel girder on the ceiling, a wooden block with a screwed-on steel projection (Fig. 6) may be screwed into a wooden beam, or into the ceiling itself in some cases.

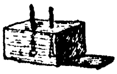

FIG. 6

The Hydrometer of Variable Immersion.—Take a test-tube of thin glass, say 6 in. by $\frac{5}{8}$ in., place it in water, and put leaden shot in it until it floats vertically. Then add about half as many more, and about a cubic centimetre of solid paraffin wax. Melt this latter, holding the tube as nearly vertical as possible, in order to fix all the shot in position. Cut a piece of squared paper long enough to reach from the wax to within 2 cm. of the top of the tube and wide enough just to fit round the inside of the tube. Make quite sure that this paper can be removed from the tube and re-inserted in its exact position, and cut a cork to fit

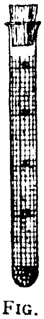

FIG. 7

the top of the tube, but not to project more than 1 cm. above the lip. Before proceeding to graduate the tube number the horizontal heavy lines so that any line can be identified (Fig. 7).

To graduate the instrument secure three glass jars, and in each place liquids of known density such as methylated spirit, water, strong brine or sulphuric acid (if the latter, this jar should be placed in a sink, and the usual precautions observed). Immerse the instrument in each liquid successively and note the number of the horizontal line on a level with the surface of the liquid. Having secured three readings, remove the squared paper from the interior, pin it down upon a larger piece so that horizontal and vertical lines coincide with those on the large piece, and proceed as follows: Draw two vertical lines about 1 cm. apart

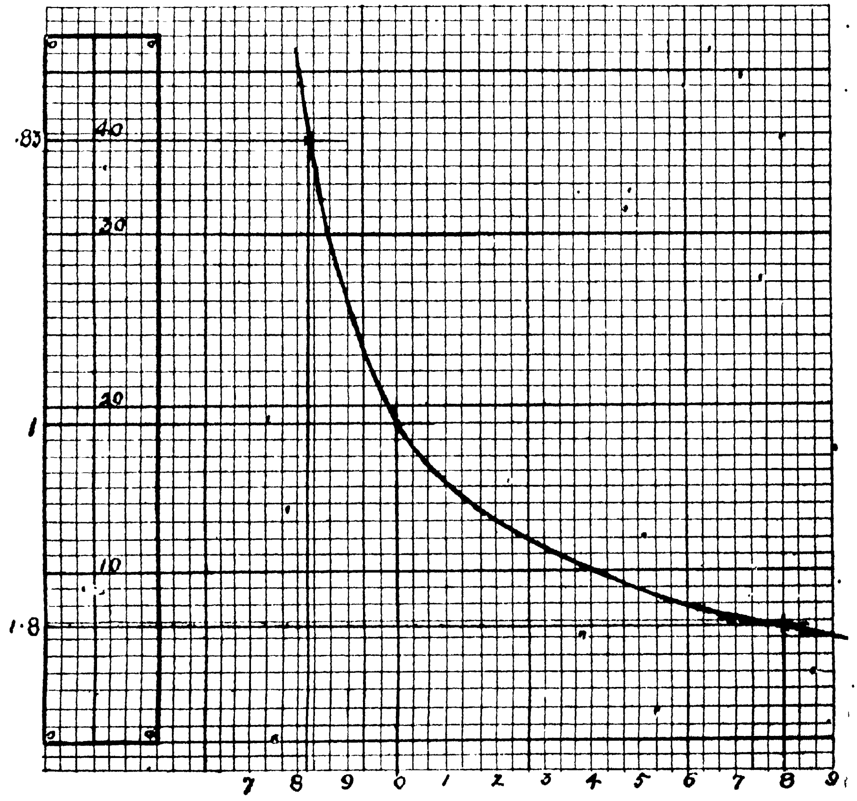

Fig. 8

down the cut paper. Draw a horizontal line from the bottom of these and mark along it spaces representing 0, 0·5, 1·0, 1·5, 2·0.

Co-ordinate the real density of the liquids along this line, with the actual heights to which the instrument floated as shown upon the vertical line, thus securing three points upon a graph. Draw the graph, and then transfer through it to the vertical scale the heights which will correspond to densities from 0 to 2·0 in tenths. Draw and number these divisions between the two vertical lines (these will be the only marks upon the paper), re-roll it, and re-introduce the paper into the tube in exactly its original position.

The instrument is now complete (Fig. 9) and may be tested against a purchased one by immersion in any liquid, or checked and calibrated by a series of determinations of density by some method involving weighing.

The Hydrometer of Constant Immersion (*Nicholson's*) is easily made as an exercise in metalwork. The upper and lower trays, A and C (Fig. 10), should have turned-up rims, the central supporting wire should be of iron, and run through the instrument, and the disc B may be exactly similar to the two trays. The shape shown in the sketch will be found much more easy to make, and quite as useful as the more elaborate bought patterns.

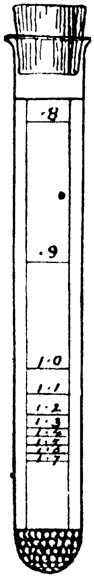

FIG. 9

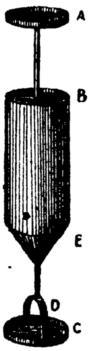

FIG. 10

The instrument may be made of tin plate, or thin brass, either of which solders easily. The joint down the central cylinder may be lapped or turned over, according to the skill of the workers, and the bridge D may be made of a strip of the same metal. This will allow of an easy attachment for the rod, which goes through the strip and is fastened with solder. The conical part E should be developed geometrically from the known dimensions, and it should be fitted, leaving a perfectly smooth rim.

The mark of constant immersion on the upper stem should not be omitted.

Mechanics (Fluids)

Barker's Mill.—This instrument is almost equally easily made in metal or glass. Thin sheet brass is recommended for a metal one.

From a piece 12 in. by 4 in. cut two strips 1 in. by 4 in. each, and bend these into tubes round an iron mandrel. Bend the 10 in. by 4 in. piece remaining round a mandrel, also into a tube. Lap or butt joints are quite good enough for this job, and less likely to cause oscillation by overweighting one side of the cylinder. Cut four holes in the cylinder about $\frac{1}{2}$ in. from the bottom, into which the smaller tubes will fit tightly. Solder a brass disc into each end of the two small tubes, saw them into 2-in. lengths, fit them into the holes in the larger cylinder and solder them in place.

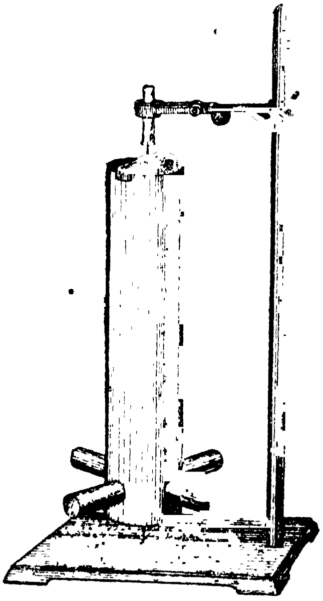

Fig. 11

Introduce a brass disc which fits tightly into the bottom of the cylinder, so that it is recessed about $\frac{1}{16}$ in., and solder it in place round the edges.

Solder a brass-headed drawing-pin in the centre of this disc, point downwards, and drill four $\frac{1}{16}$ in. holes in the sides of the short tubes, so that each hole faces the same way when the arms come round. On the top of the body solder a brass strip with another drawing-pin fastened to it, point upwards.

Mount the instrument by allowing it to stand upon a retort stand (Fig. 11), the upper drawing-pin passing just inside a short length of glass tubing held by the clamp.

When a stream of water is directed vertically into the instrument, which may be placed in a sink, continuous rotation takes place.

In glass, the chief difficulty is the sealing in of the side tubes

—an operation made unnecessarily difficult by the weight and unwieldiness of the glass cylinder. This may be overcome by sealing the four side pieces into a vertical tube about ½ in. internal diameter, and subsequently joining this to the main cylinder, suitably reduced in diameter at the junction. Failing the skill to make this joint, the body of the instrument may be closed by a cork, bored to take the jointed tube, the other end of which is drawn out to a point providing the support for the whole. (Fig. 12). The upper end is supported in the same way as the metal one, but the brass clip is sprung inside the tube instead of clipped outside it. The four jets are made by pulling out the side tubes, and bending to shape before the glass has quite hardened, afterwards cutting off to the right length.

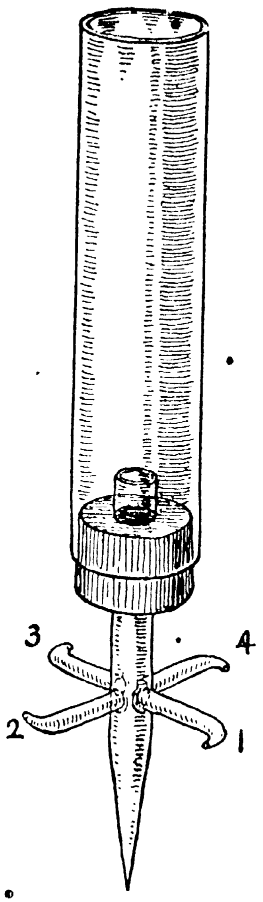

FIG. 12

In making the glass base piece, opposite pairs of side tubes should be sealed in—the order being 1 3 4 2 (Fig. 12), and the central piece should be kept hot all round until the whole is complete. The operations proceed in the following order :

Follow the operations shown on Fig. 13, making a cross-piece as shown. The centre at A (Fig. 13) is next enlarged as in No. 2, then the opposite side as in No. 3, after which top and bottom tubes may be sealed in, the point sup-

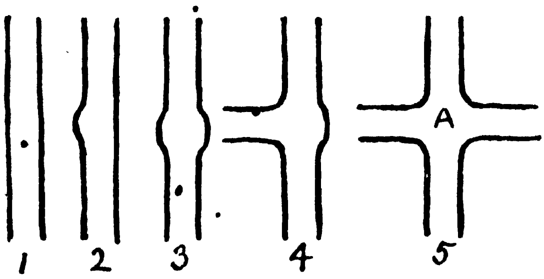

FIG. 13

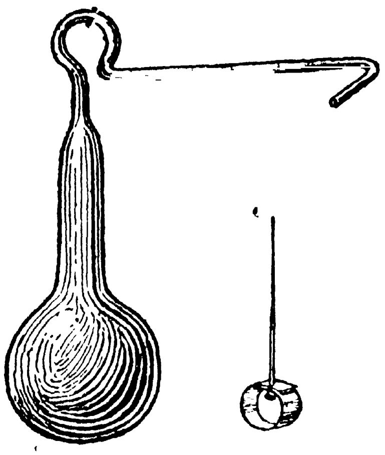

Fig. 14 Fig. 15

porting the whole, and the side jets may then be formed.

A simple variant of this instrument may easily be made from a piece of ordinary glass tubing. Blow a bulb upon a piece of 4 mm. tubing, and draw out the tube to a long strong point. This is done by heating the tube to the point when it begins to collapse, and then pulling apart very slowly, turning the tube round meanwhile; by this means the glass is kept thick and strong, and the elongated tube produced is central with the bulb. By heating with a very small flame, the thin tube may be moulded into the shape shown in Fig. 14. The bulb is filled with water by heating it slightly over a bunsen and dropping it bodily into a beaker of water. Each time it is used, and before it cools, it should similarly be dropped into water, when it will always be ready for use.

The bulb is supported by a little strip of aluminium or copper foil $\frac{1}{8}$ in. broad and $\frac{3}{4}$ in. long bent into a circle, with ends overlapping $\frac{3}{16}$ in., and having a pin passed through the overlap. The pin may be stuck into a cork or piece of wood and held in a retort stand clamp (Fig. 15).

This little instrument is within the power of quite small boys to make, and is as instructive as the more ambitious models made in accordance with the instructions given above. Teachers may find it fill a gap conveniently.

Hare's Apparatus.—The principal difficulty in the way of using this admirable instrument is that of measuring accurately the heights of the compared columns of liquid. The reasons are various, and are mainly connected with the method adopted for supporting the tubes, and with the fact that one does not care to employ boxwood scales in experiments involving the use of alcohol or caustic liquids. A careful survey of requirements, however, leads to the following modifications of the usual design

1. No wooden stand is used as backboard, the tubes being freely supported by retort stand clamps.

2. Tubes bent in the shape ┐ may be supported by the short limb, and leave the vertical tube quite free.

3. A paper scale pasted upon a rebate cut in a strip of wood having a few inches of glass rod stuck in the end will remove all other difficulties.

The wood is a piece of satin walnut, 15 in. long by, say, ¾ in. square section, rebated ⅜ in. by ⅜ in. On the face A (Fig. 16) there is pasted a strip cut from a sheet of millimetre graph paper, and projecting a few centimetres beyond the end of the wood strip. When the paper is quite dry, a hole is drilled up the wooden strip, sufficiently wide to take a piece of glass rod (pointed at one end) and one or two inches long. The rod is then heated, smeared with cement such as "Chatterton's Compound" or "Faraday's Cement" and pushed into the hole until the pointed end coincides with the projecting end of the paper strip, which should, of course, be cut off at a centimetre line. The zero of the scale is now the end of the glass rod, and when all is set and cold the paper scale may be numbered, the projecting piece of paper being, of course, removed.

The rebate enables this "scale" to be fitted quite close to the glass tube, through which the scale is read—the bottom of the meniscus being read as usual. The glass rod enables the observer to detect with great accuracy the moment of contact with the surface of the liquid, and if the scale be placed by the side of the tube, pressed to it, and gradually lowered till contact is made, very accurate and consistent readings may be taken. The glass rod may, of course, be used in any liquid without injury, and the scale never comes into contact with the liquid.

Overflow Jars—for the determination of the volume of irregular insoluble bodies—may often be made quite simply from broken tubes and jars.

If the bottom of a boiling tube be broken out,

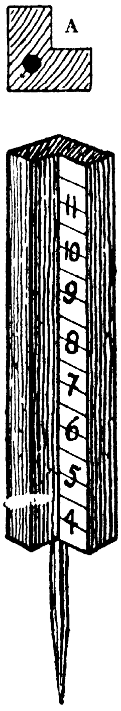

FIG. 16

it is readily converted into an overflow jar as follows: Fit a cork carrying a tube to the mouth of the boiling tube, in order that it may easily be handled, and heat in a large blowpipe flame gently at first and strongly as the glass softens, allowing the glass to collapse and thicken at a point about half-way down the tube (Fig. 17). When considerable shrinkage has taken place, draw the two pieces apart slowly, rotating each equally all the time, and removing from the flame during the process of pulling (Fig. 18). By this means quite a stout-walled tube of small diameter is drawn from the original one and this may be shaped as figured (Fig. 19). (Note.—If the tube be drawn too quickly, a long pointed end will result, and this will be difficult to use.) The smoothly curved base may be obtained by blowing a puff of air into the tube *while bending* the side piece. This prevents collapse.

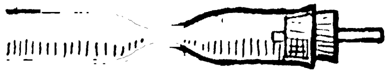

Fig. 17.

Amount of Shrinkage necessary before Drawing

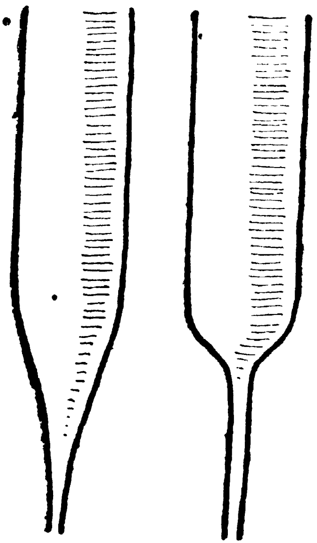

Fig. 18

Tube Drawn Quickly

Tube Drawn Slowly

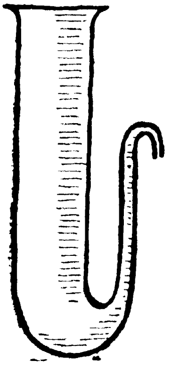

Fig. 19.

Final Shape

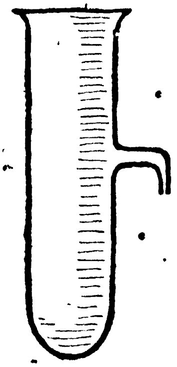

Fig. 20.

Side Piece Sealed in

A second way of using up a similar broken boiling tube would be to seal a tube of small diameter into the base instead of drawing it out as shown above. To do this it is necessary to blow a bulb on the narrow tube, and to widen it out to fit the drawn-down end of the boiling tube, afterwards joining where the diameters are equal. In this way a similar vessel is made.

If the boiling tube be broken at the top, it is sufficient to seal a side tube in, about 2 in. to 3 in. from the bottom (Fig. 20). This is best done by fitting a cork as before, heating the tube *all round* where the joint is to be made, and sealing-in in the usual way. When the joint is finished the blowpipe flame should be turned up and the whole section of the tube in which the joint occurs made thoroughly hot, setting aside to cool out of draughts.

To cut the top off level the following method usually gives the best result—make a mark with a sharp triangular file across the tube (slightly wet the file); then take a glass rod 5 mm. diameter drawn down to 2 mm., heat the point till quite soft, and press firmly down upon the mark. Usually a crack will start in two directions in line with the file mark; but it may not continue straight for more than a few millimetres. Heat the rod again, and place it about 5 mm. in front of the straighter end of the crack—the crack will immediately run to the hot rod, and by continuing this process, the crack may be led just where one wishes.

A thin tube cut in this way rarely cracks when put into the flame to round off the edges, and a long charcoal pyramid, introduced and turned round while the edges are soft, adds the professional "beading."

The use of such jars as these for volume determination brings about much useful work. For example, it will soon be noticed that for small solids consistent results are not always obtainable owing to the difference caused by the last drop, and boys will sometimes shake the instrument to collect this last drop and so ruin their results.

There are two ways out—(1) to circumvent the actual trouble; (2) to alter the instrument and so remove the trouble. Each way is good, and either principle may have to be adopted in experimenting. The first method would, in this case, be illustrated by the method of original setting of the instrument—by working slowly and setting the instrument by an identically similar process to that in which afterwards it will be used. In this case it must be set by dropping a small body in, after the water level has been made right, then substituting a weighted beaker for the old one, dropping in the new body and weighing the discharged water that falls into the beaker, irrespective of the position of the last drop.

The alteration of the instrument is readily enough effected, once a few bad results with the instrument as at first devised have shown the error and indicated a remedy. It is obvious that if we could affix some sort of constant control at the end of the delivery tube, which would decide when water might pass and when not, the trouble would disappear.

As a fact we have such a control in surface tension—a control which is so strong that it must be used carefully. As we desire our instrument to work accurately to the nearest drop, we must allow the tube to be fairly open, about ⅛ in. in diameter, with perfectly level and smooth edges. By doing so, a drop of water only half-squeezed out of the delivery tube will be sucked back by surface tension, but if it should be more than half out, surface tension will eject it. The finding of the correct diameter of tube (different, of course, for every liquid) is a matter of experiment, but it is worth doing as an exercise in finding a definite and sharp "end point." The question of a sharp "end point" generally decides between two otherwise equally good scientific methods, and it is well for scholars to realise quite early the importance of this factor.

Two other "volume" methods may be given; experiments upon a single body to evaluate the accuracy of each method will provide good training for an elementary science class, and the objective is far more valuable than the mere determination of the volume of the body in question.

1. Method giving a fine end point.—A beaker of water is placed upon a wooden block, and a strip of wood through which a pin or a darning needle has been driven is stood upon the beaker. A syphon ending in a piece of indiarubber tubing and carrying a pinch or screw-clip passes into the beaker, and discharges into a weighed vessel conveniently placed (Fig. 21).

Water is filled into the upper beaker until over the point of the needle, and is then drawn off through the syphon (held in one hand and the clip worked by the other, in order to keep it perfectly still) until the thread of water between the surface and the needle parts. This point is definite, constant, instantly noted, and regular to a drop, *if the diameter of the upper beaker is not too great.*

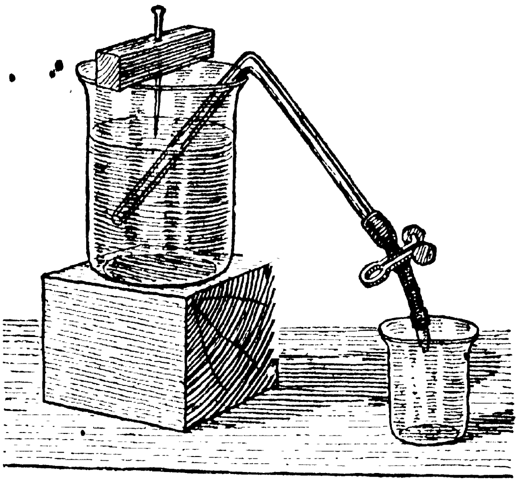

Fig. 21

The instrument being set, a weighed empty vessel is placed in position, the body whose volume is to be determined dropped into the upper vessel, and water drawn off as before. The weight of discharged water must not be given beyond the first place of decimals of a gram (though weighed to the second) for obvious reasons.

2. Direct method.—The same end point may be used—a needle passed through a strip of wood, but the liquid is drawn up into a burette by sucking air out through the indiarubber tubing (Fig. 22).

The instrument is set by allowing water to rise in the burette until the thread of water breaks. The burette reading is then taken, the body introduced into the beaker, and water again withdrawn into the burette until the same end point occurs. The difference of readings gives the volume correct to the first place of decimals.

It is true that these examples involve little making of apparatus; they involve the intelligent use of units mainly prepared by other people, and a little supplementing by their own home-made details.

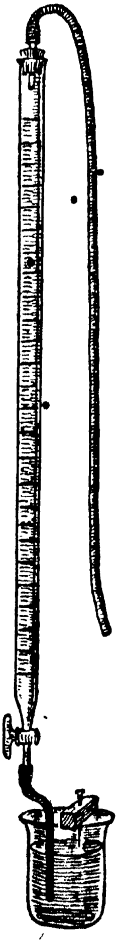

Fig. 22

But this is really what science was introduced into schools to provide, and if the science is to be taught upon research lines, if it is to be a personal inquiry, it is as necessary to save time by using part of some standard apparatus as it is to be able to supplement that standard apparatus by some addition that will enable it to be used for some quite unintended purpose. It is this training that makes the eager, resourceful competent citizen much more than training given where every possible requirement is provided.

Further, work done with the object of comparing efficiencies of two or more methods is educationally superior to that done merely for the discovery of some piece of specific information. It is because of the many comparisons, the weighing and balancing of many attributes, that arise out of science work, that the subject is such a valuable training for life. To make science a mere search for detailed information, to be satisfied with experiments which merely corroborate results tabulated in books, is deliberately to refuse the best service of an admirable tool, and to kill the spirit of personal research which is the very essence of living. Such teaching can only be done, however, with the conscious co-operation of the boy; incidentally the handwork skill must be of a high order, so that a boy may venture, may dare, with assurance.

HEAT

A Thermometer.—According to our ideals it is a question whether a thermometer is worth making, at least from the beginning, but as it affords a fair example of an instrument needing several contributing "subjects," it may be given here. If it can be made in two lessons, as it should be, the time will not be grudged, for the instrument is of permanent interest, and the graduation provides excellent experience. Boys who need to make thermometers, however, rarely work at this speed, and I have found it work well, when dealing with apparatus of this kind, which most boys desire to make, to bargain with them beforehand that a certain amount of time would be spent upon it, and that those boys whose work remained incomplete at the end of that time could, if they wished, finish it out of school hours.

Those boys who work well, will finish; those who do not plan will be behindhand, but will be sufficiently close to be able to complete the work without further instruction. The unskilful hand workers probably will not finish, and, realising their incompetence, will be glad to turn to other matters. They will probably learn as much by seeing thermometers being made around them as they would by eventually (at an enormous cost of time and supervision) making one themselves.

I would like to suggest that the blown bulbs be provided. A science teacher will make a dozen good bulbs or thermometer tubes in half an hour, and his class will take some days blowing the same number of bad ones. Here is a case where the time expenditure is not worth the return.

I have found it best to make an alcohol thermometer, and to proceed as follows: Fix to the bulbed tube, which should have a bore of about 1 mm., and will require a bulb of about 15 mm. diameter to give a suitable scale, the top of a thistle funnel, or —what does equally well—a piece of wider bore ordinary glass tubing, by means of a piece of indiarubber tubing. Clip this in a retort stand clamp, fill with methylated spirit containing a little magenta (1 gram per litre is sufficient), and gently flick a bunsen flame around the bulb. When the bubbles cease to rise through the coloured liquid, the flame is withdrawn, and a cool duster wrapped around the bulb, replaced in a few moments by a beaker of cold water.

If the bulb does not fill, repeat the process, but not more than once or twice—it is only necessary at this stage to fill the bulb, and the " air bubble " remaining is generally alcohol vapour, which can be condensed under the tap. After cooling completely under the tap, the bulb will be mostly full, and the stem completely so.

The reservoir is then detached, and the tube held vertically, when any bubble which remains in the bulb will try to pass into the stem, and a few sharp shakes will enable it to do so. The bubble is by this means removed from the bulb to the stem without going through the tedious re-heatings usually necessary. Then draw out the top of the tube in a blowpipe flame (Fig. 23), taking care to heat the tube above the alcohol level (one reason

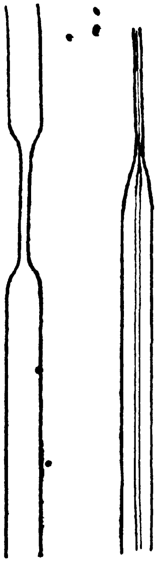

FIG. 23

for not completely filling the tube). Do not close the top, nor allow the glass to collapse too completely; heat the tube evenly all round, and allow it to soften thoroughly before drawing. Then, when cold, snap off the tube, leaving just a capillary.

Place the thermometer in a beaker of water heated up to 70° C., and having a standard thermometer in it to keep a check on the temperature. The excess of coloured alcohol will spill out, and when no more exudes, a bunsen flame applied for a moment to the tip of the capillary tube will close it. The thermometer may now be withdrawn from the beaker, and transferred to a funnel of melting ice, to find zero. If zero stands nearer than about 2 in. to the bulb, it would be better to open the top, and introduce some more coloured alcohol (easily done by crushing the tip of the tube with pliers, while under the surface of coloured alcohol in a basin), repeating the process of closing, but at 60° C. instead of 70° C. as before. Find the new zero, if in a satisfactory position mark the height of the alcohol by a rubber band cut from the end of a piece of ⅛ in. india-rubber tubing. Next secure a second fixed point by placing the thermometer alongside a standard one in a beaker of water and heating gently to, say, 50° C. Mark the level as before.

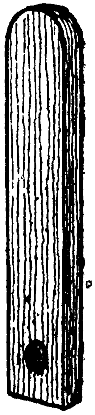

FIG. 24

The instrument is now to be mounted upon a board which should, at this stage, be ready. I have found the very best base to be an extremely simple one—it is cut from "satin walnut" about 10 in. by 1½ in. by ½ in., and has a ½ in. hole drilled well into the wood about ¾ in. from one end, and on the centre line of the face (Fig. 24). That is all I need—some boys prefer to chamfer the edges all round, some make a semicircular top, some do this, some that: I do not mind, so long as the hole is there.

Upon this face, I mount with thin glue a strip of drawing paper, cut to width, and having a ½ in. hole cut out (with a cork borer) in the right place. The drawing paper is pressed while drying, and is not ready for the scale until quite dry.

The thermometer is now placed in position, and the fixed points transferred in pencil to the paper. The size of the hole will be such that the instrument may be taken up and exactly replaced any number of times. The rubber rings are therefore removed and the scale completed. This is done by drawing two parallel lines on each side of the tube, the space between the two pairs being just wide enough for the tube itself. One side should be graduated in ° C., and the other in ° F., for in the drawing of these scales lies quite half the educational value of the instrument.

If the figures suggested have been used, and the fixed points are at 0° C. and 50° C., it is only necessary to divide the distance between them into five equal parts on one side and nine on the other (by any familiar geometrical method) to secure the 10° unit of length for the Centigrade and Fahrenheit scales respectively. Further, as 60° C. coincides with 140° F., a horizontal line at this point gives a convenient starting-point for marking the Fahrenheit scale, checking by another coincident ten at 50° F. and 10° C.

Having marked the 10° spaces, and completed the scale above and below, single degrees on the C. side, and 5° divisions on the F. side may be added, and the thermometer permanently mounted by metal clips nailed or screwed into the base.

It is curious to note that my experience here is that it is better to nail (with escutcheon pins) the brass over-clips than screw them to the base. The reason appears to be that a boy takes great care with a hammer, which he recognises as a dangerous instrument in this connection, and he measures his striking distance exactly, and holds the tool correctly. Further, by holding the clip with the thumb of the left hand, and having the thermometer base at right angles to the hammer shaft, there is little danger of striking the tube. In screwing, however, the turnscrew sometimes slips off the screw head, and great damage inevitably results to scale or tube if this be the case.

The instrument when finished is very plain; but a condition was that it had to be finished in two lessons. Unnecessary elaboration is a fault; if a boy desires a more ornate and impressive instrument (which will, however, not record temperature any more accurately), he may make any number in his own time.

A Recording Thermograph.—A useful and interesting piece of work for any boy who is particularly keen on thermometric observations is the making of a recording thermograph. The indicating section (Fig. 25) is made as follows: A piece of bar iron

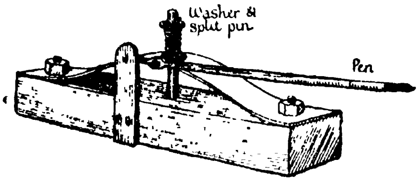

FIG. 25

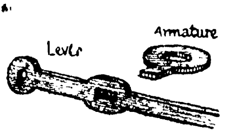

FIG. 26

1 ft. long by 1 in. by $\frac{1}{2}$ in. section is drilled near its two ends, and a strip of aluminium 1 in. wide, 13 in. long and about $\frac{3}{32}$ in. thick, is bolted in the form of a bow upon it. An upright rod passes from the centre of the iron bar up through a hole (the edges of which it must not touch) in the aluminium strip, and this rod carries a spring which presses down on the top of the strip.

One inch from the centre of the iron bar a support is raised strong enough to carry the fulcrum of a lever, and a small brass armature is cut from a thin plate of that metal, which, passing between spring and aluminium strip, enters a slot cut in the lever (Fig. 26). The lever carries a pen and is made of thin aluminium or brass. Its length depends upon the scale desired.

Owing to the unequal expansion of iron and aluminium, the "bow" alters its width with temperature, and this movement is multiplied in the above very simple way so that the point of the lever travels over a suitable scale. The scale may be of paper mounted near the point of the lever, for the whole instrument will naturally be mounted on a baseboard; but to make it into a recording instrument a clock-work drum must be added. This is made by fastening the works of a cheap clock inside a tin case, and fixing a brass tube of the same diameter as that to which the hour hand is attached firmly to the baseboard (Fig. 27). A small stand is

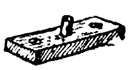

FIG. 27

required for this; on removing the hands of a clock, and pressing it upon the upright tube, the clock will revolve upon its axis once in twelve hours.

If the usual legs and ring have been removed, and replaced by countersunk bolts (or a drop of solder), a paper cover may be wrapped round the clock case, and the whole mounted in such a position upon the baseboard that the pen on the end of the lever will make a trace upon the paper, and variations of temperature be recorded.

The exercise is not an easy one; the recording portion particularly requires very exact work, but quite a good instrument may be made by any one who cares to take a little trouble.

It may be noted in passing, that springs may be made by winding steel piano wire round a wooden mandrel somewhat smaller than the desired diameter of the spring, pulling strongly upon the wire while winding.

Heating by Convection.—A useful model for illustrating the warming of a house may be made by the co-operation of a class of boys having a reasonable amount of skill.

A baseboard is required, which may be roughly shaped like the section of a house, and this provides work for the best woodworkers. Less skilful hands provide a number of metal clips which eventually fasten the tubes to the board, while the best of the boys try their hand at bending spirals of glass tubing. This latter may conveniently be done by bending the tube round a hollow cylinder made of sheet brass with a cork at each end. The glass tube is heated in a blowpipe and allowed to fall around this cylinder, which is turned as required. When three or four complete turns have been made, the whole is cooled and the cylinder withdrawn after collapsing it by sliding the edges over each other.

A flask has to be cut down, corks bored and glass tube to be cut to various lengths as planned out upon the board, or upon a full-sized paper pattern of it.

When all the parts have been brought together, erection is commenced (Fig. 28), and the model finally tested. In the course of the test there may arise two necessities or refinements—first, the need for some colour-temperature indicator; second, for a delicate

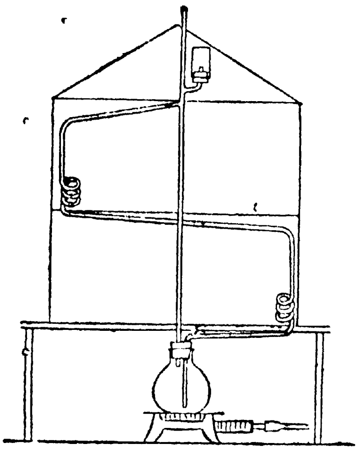

FIG. 28

quantitative temperature indicator. The first is solved by the use of a dilute starch solution (potato starch by preference, as this is not opalescent) coloured by the addition of a drop of dilute iodine solution. This liquid is blue at low temperatures, but loses its colour at about 90° C., so that the path of the heated water can be traced. The second difficulty may be overcome by the provision of a screen for the radiators (the spiral tubes) and an air thermometer fitting inside the coil.

Air Thermometers (Fig. 29) are made without difficulty by sealing a piece of 4 mm. diameter glass tubing upon a piece of fine bore thermometer tubing, and bending this latter into a U-manometer. A further refinement of this little addition is the provision of a means for setting to zero at any time. The air thermometer is sketched. These refinements should, however, not be pressed at first. They need not be used unless the necessity for them arises, or unless their need is anticipated by some scholar.

The model may, of course, be elaborated to any extent so as to represent more accurately actual heating installations, but this simple device illustrates the principle involved, and this is usually sufficient.

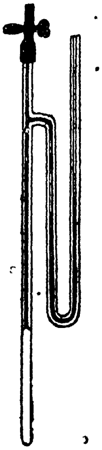

FIG. 29

Liquefaction of Gases under Pressure Apparatus.—Sometimes the necessity for demonstrating the liquefaction of gases under pressure will arise suddenly in a class. A simple device for this purpose (Fig. 30) is composed of a closed tube containing sulphur dioxide, dipping under mercury in a strong bottle, and fixed in place by a rubber stopper. The stopper should have a disc of brass above it, and be wired to the neck of the bottle. On connecting the side

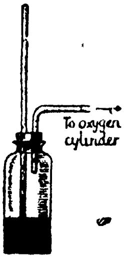

FIG. 30

tube to an oxygen cylinder, and gently admitting oxygen, one makes use of the pressure of the gas without using any appreciable quantity of it, and the column of mercury compresses the gas as it ascends.

A Non-return Gas Valve.—A simple non-return gas valve, much stronger than a bunsen valve, may be made by placing a piece of rubber tubing over the end of a glass tube closed at one end and having a hole at the side. Such tubes are easily made, and the valve is very useful in experiments on pneumatics. Any bicycle-pump may be used to force air into an enclosure protected by such a valve (Fig. 31).

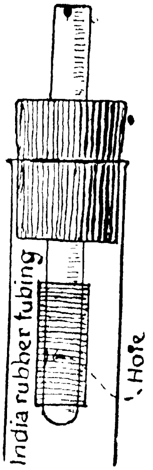

FIG. 31

GLASS BLOWING

Its Value to Teachers and Students.—Chemical apparatus may very rarely be said to be "made." Usually it is erected from units found in every laboratory—beakers, flasks, burettes, tubing. The one valuable attainment is the ability to bend and weld glass tubing into any desired shape, and this comes in the main by practice. A few hints upon this art may not be out of place, but space does not permit detailed instructions, for which readers are referred to more specialised works.

Glass bending is described in most text-books of chemistry and physics; the rule laid down is that no tubing should be bent save in flame from a fish-tail burner. But if the tube is held high in the flame, and sloped so that as much of the tube is heated as would be heated by a fish-tailed flame, the bunsen may be used, with much saving of time. A Ramsay flame-spreader also enables a bunsen flame to be used for bending. Other than this, the usual instructions appear to be quite satisfactory.

A few notes on simple glass working may be of service, for upon one's dexterity with this material depends to a very great extent the amount of personal investigation possible.

Every student of science should be able to bend and joint glass rod and tubing up to $\frac{3}{8}$ in. diameter, and every teacher of science should be still more expert. The processes are quite simple; only practice being necessary once the control of the material has been learned.

Methods.—*The Flame.*—The most important factor is the blowpipe flame. Messrs. Fletcher, Russell & Co. put up a blowpipe (C.10 on stand) at 12*s.* 6*d.* which, blown by a No. 3 bellows, will do all the necessary work. The flame is a good shape, easily controlled, and capable of rapid and fine adjustment. More expensive ones there are, but none better.

The flame to be used in all glass working is the largest that is convenient, as it is most necessary to keep a considerable area of the work hot, and not to localise the heat. The glass must reach the temperature at which it flows or coalesces, and any lower temperature merely causes an imperfect joint which will crack at the least strain or temperature-difference. Novices invariably try to work at too low a temperature. Work which is good needs no annealing; it is better for jobs to crack while in the making than during an experiment; and if time is to be saved in the end, it is better in the making to treat all work more severely than its intended purpose will, in order to be quite sure it is reliable.

There is only one place for glass in a blowpipe flame, that is just past the tip of the inner cone—nearer to the nozzle will cool the glass unequally and crack it, further away does not utilise the full temperature of the flame, which is therefore larger than the job needs, and is softening too much glass.

A quiet flame is hotter than a roaring one—too much air is being passed through the latter, and glass blowing is a dainty and delicate operation, for which the quiet, gentle, unurged flame is necessary.

Glass perishes with much heating, therefore the quicker a job is done, the better.

When bending tubes under the blowpipe flame, keep a moderate pressure upon them from the inside, in order to prevent collapse. (The air acts like the plumber's sand in a pipe, or the lead in a copper pipe while bending.)

Keep the glass always moving, rotating wherever possible, remembering that unequal heating means unequal strain, and this means a crack on cooling.

It is better, in a laboratory, to have a stock of small units from which elaborate apparatus can be fitted up, than to have such apparatus permanently mounted all in one piece, and used possibly but once a year. Thus bulbed tubes of various shapes, T, Y, and X pieces are always useful; bent pieces accumulate with sufficient rapidity.

In fitting up apparatus, it should be a condition that the joined glass tubes touch each other; the indiarubber tubing should not connect so much as attach and bind the tubes—its elasticity should be used to bring the tubes together. Any other state is sure to lead to trouble. Loops of indiarubber tubing, sloppy, untidy-looking fittings, parts that fall over and look unbusiness-like—all these count against the very spirit of the science training itself, and help to defeat its object. Every piece of apparatus fitted up should be a sound piece of engineering, as well as a satisfactory chemical appliance.

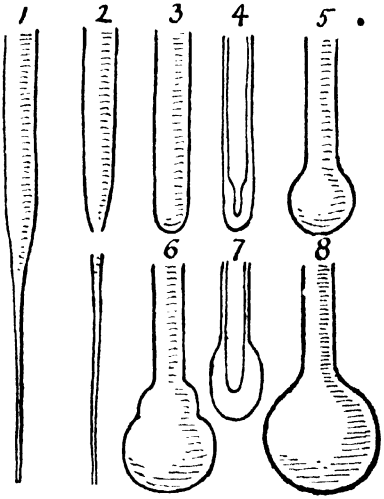

FIG. 32

The Blowing of a Bulb is a simple business, the blowing of a strong and spherical one is a different matter; but if the phases shown on Fig. 32 are worked through the resulting bulb should withstand the shock of dropping on the floor from a bench, which is usually all it will have to endure afterwards.

A bulb in the middle of a tube is rather difficult to make strong and central. The best way appears to be to work exactly as though the bulb were at the end of the tube, allowing the rest of the tube to slip easily between the thumb and finger of the left hand, until the time for the final blowing, when the two ends of the tube should be pressed gently together during the period of blowing. Personally I find it much the best way to do all blowing with the tube held quite horizontally, and to invert the tube when the glass falls away from the horizontal, allowing it to fall back before blowing. Some people prefer to hold the tube vertically, claiming to get the bulb more central by this means, but there appears to be a tendency to produce bulbs of elongated shape by this method.

T, Y, and X pieces are made by following the diagrams shown on Figs. 32, 33, and 34 respectively, remembering that glass must be of equal thickness and equal temperature before joining, and that so long as the material is under control, the hotter it is the better.

Glass Jars or Boxes.—Frequently there arises in schools the need for some small glass jars or boxes, with plane sides, and generally these are not easy to purchase having all dimensions suitable. As they are extremely easy to make, and one's sense of the fitness of things is charmed and satisfied by their use, it may be well to give a few directions for their construction. They are used as specimen jars, cells for observation of low forms of plant life, for crystallisation, as live boxes, and for many other similar purposes. Their making, it should be understood, is only advocated when other suitable vessels are not obtainable. If a stock size purchased vessel twice as large will not actually spoil the purpose or rob the illustration of value, there is no sufficient reason for spending time in making the exact article desired. If, however, a definite space has to be filled, if the exceeding of one dimension will cause trouble, delay, uncertainty, or a bad appearance, the construction is justified.

The glass used should in all cases be that known as "Patent Plate." The trouble is the same as with common window glass; the cost is, for small pieces, very little higher. The result, however, is incomparably better in every way, the surfaces being plane, polished, equally reflective and equally refractive at all points. The sizes of glass plate required should be decided upon, and the pieces purchased, ready cut, from the glazier. This for two reasons—first, it gives the glazier an opportunity of using up small pieces, and secondly plate glass should be cut by an expert.

There are two ways of joining up cut pieces into boxes, (1) by means of butt joints; (2) by means of mitred corners (Fig. 36.) The second method is decidedly to be preferred in most cases, as it provides a better grip for the cement, and the joint is less likely to leak. It is, of course, more trouble.

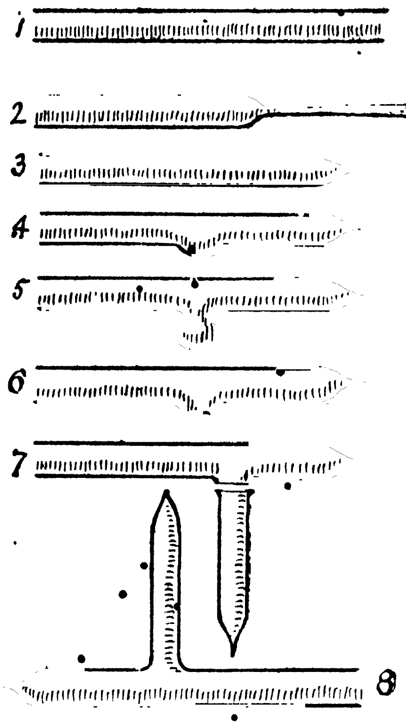

FIG. 33

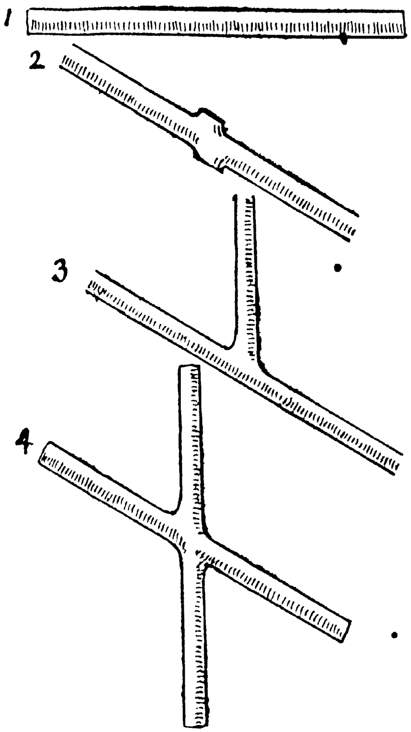

FIG. 34

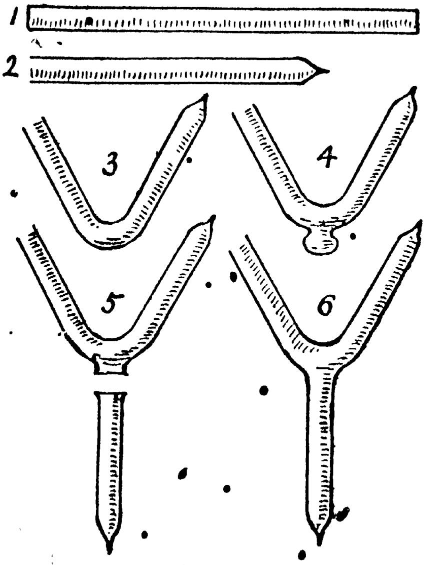

FIG. 36

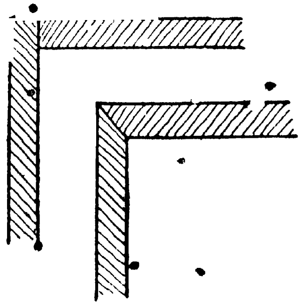

FIG. 35

An easy method of grinding is as follows: Take a piece of emery paper (grade 1), place it upon a flat bench and pin down the corners. Sprinkle upon it either emery powder (coarse knife polish) or powdered carborundum (No. 90), such as is used for the grinding of motor valves, and moisten with turpentine, which keeps the glass cool during grinding. Then rub the corner of the glass upon the paper, grinding with even pressure and a circular motion and keeping the glass sloped at an angle of 45°, in order to cut a correct mitre.

As grinding proceeds, the corner should be watched carefully in order to see that the edges remain parallel; it will not as a rule be necessary to use finer grinding material, as a fairly rough surface provides a better grip for the cement.

Cementing.—Each corner is treated similarly, and the whole cemented together (after thoroughly cleaning) with a suitable cement, binding together, while setting, with thin wire or thread.

Two cements are recommended; Chatterton's compound, which is applied as if it were sealing wax, and acetic acid cement. This latter is made by soaking gelatin in water for an hour or two until it has swollen and become soft, pouring off the water, melting the residue and adding an equal bulk of glacial acetic acid. Before use it must be melted to a thin clear liquid, mixed with an equal bulk of superfine plaster of Paris, stirred well and applied while hot to surfaces which have been recently warmed in order to dry them thoroughly. Cells put together with Chatterton's compound should not be used for benzene, alcohol, petrol, etc., but the acetic acid cement will withstand the action of all liquids.

The sides may be cemented to a base in exactly the same way, and a lid or cover made similarly. Or a lid may be cut and ground from a single plate, and fastened to the cell wall by a strip of gummed paper such as is used in the binding of lantern-slides or *passe partout.* This binding strip may, indeed, be used to strengthen all the joints, but it should not be necessary.

Ends of glass tubes may be ground at an angle by similar means without any danger of cracking, indeed cells may be made up from wide tubing, cut by the method of leading a crack, and ground accurately as above.

Cutting and Drilling.—Carborundum powder is the most rapid cutting agent at present obtainable. It cuts best with water as a lubricant (probably because of the high specific heat of water), but water cannot be used on emery paper inasmuch as it softens the glue which holds the emery in place, and so destroys the paper. Glass may be drilled, or a round hole cut through, by a wire or copper tube respectively, fed with carborundum and water, and rotated firmly against the glass.

Conclusion.—In the above notes, I have endeavoured to indicate the reasons which seem to me to govern the choice of the apparatus to be made, as well as to give such details of technique as will enable some units to be made in their simplest possible form. It must be understood that as a rule, and for schools in particular, the simplest apparatus is the best. Refinements come later, when the need for them is more apparent, and when they are deliberately introduced for a definite purpose—and frequently that necessitates a bought instrument.

While it is unquestionably good to have delicate instruments at our command, and while the moral value of a tool that requires caring for is certainly not to be neglected, there is a very real danger of cramping initiative and restraining imagination by supplying a wealth of purchased apparatus, each unit specialised, each piece designed to overcome some particular difficulty that were better met and faced with normal tools. Fortunately such luxury is not for most of us, but there still is what I consider too great a tendency to purchase for schools instruments which leave all too little to the observer—where a gas analysis, *e.g.* becomes but a matter of the turning of taps in a certain sequence.

I want to make the point that such apparatus—suitable enough in a works, maybe—is not suitable in a school. While we are educating, let us use our subject to train for mental agility, let us see and overcome difficulty, let us deliberately plot and plan for the discomfiture of some confusing factor, and let the hard-earned triumph be our own, rather than that of some instrument designer whose very ingenuity may have blinded our eyes to wholesome truth.

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J. T. Baily and S. Pollett, B.Sc., *Woodwork for Schools on Scientific Lines* (John Murray). J. H. Woollatt, *Laboratory Arts* (Longmans Green).

L. HANDWORK DRAWING

1. DRAWING AND CONSTRUCTIVE WORK

By W. H. WINCH, M.A.

External Member of the Board of Psychological Studies for London University; L.E.A. Inspector of Schools; Author of "Problems in Education," etc.

THIS is a big subject, and to deal with it effectively would require a book, not an article. But I shall try, as far as I can, to outline some general psychological truths in relation to drawing in so far as it *does bear* and in so far as it *does not bear* on constructive work. These considerations are of great practical importance in the educational world to-day; since that aspect of drawing which issues from and helps constructive work is in danger of being overlooked in favour of a type of drawing which, based on the unassisted observation of the child, too often results in a sort of crude impressionism that outrages Nature and leaves the pupil, so far as dexterity in draughtsmanship is concerned, pretty much where he was before he began to draw.

Spontaneous Drawings.—I am not arguing against spontaneous work by the pupil; far from it, for much of my own experimental work has been concerned with the spontaneous drawings of school-children. But the pedagogical value of spontaneous work by children is to show us how to teach along the lines of the child's developing powers. It is not all-sufficient and self-sufficing, though nowadays many, if not most, teachers are acting as if it were. They are acting, I know full well, under advice with which the most experienced of them do not agree. Let me not be misunderstood. There *is* much early work in spontaneous drawing which is useful; not, however, because of its value in learning to draw properly, but for its other mental aspects.

For a child to illustrate, however crudely, the stories which it hears has a value in graphic expression which reacts on the memory of the story, and makes it more interesting for the young child. And children like to draw landscapes and human figures. They are not easy to draw; but even children, *until they find that* their efforts do not adequately represent them, will draw them spontaneously and be extremely satisfied with their productions. Long ago there was a warning from a psychologist. For Professor Sully, in his book on Children's Drawings, told us that, left to themselves in their play-drawings, children soon settled down into some one conventional way of representing things, and did not really progress. His statement is not quite true, for they do show some advance without any teaching at all; but they show very much less than those children who have been taught *how to observe* and *how to draw.*

I repeat, therefore, that the unassisted efforts of the child are not adequate to produce good drawing. Yet educationists are acting to-day as if they were. How has this profound pedagogical error arisen? It has its origin in the writings of some educationists who knew no psychology, and of others who borrowed the analyses of the classical psychologists, which, *bien entendu,* were not made for educational purposes, and applied them *en bloc* to pedagogical procedure. In no single instance has the result been more disastrous than in that relating to the psychology of visual perception. In the ultimate analysis of classical psychology we have a sort of two-dimensional extension on the retinae which is modified by eye-movements and other motor and tactual experiences into a knowledge of the three-dimensional space of the adult.

Space-Perception.—Let us suppose, for a moment, that this analysis is a true genetic account of space-perception for the school-child. On this view he has first the perception of objects as flat extensions in space, and then learns afterwards by experience that certain lines or boundaries of his objects really mean depth, and are not on the same flat plane in which some of the other lines or boundaries find a place. Of course educationists have drawn the conclusion that the child can at once represent solid objects in two dimensions on a plane at right angles to his line of vision; for according to their interpretation of the classical psychologists, that is just how he *first sees them.* Let us, say they, catch the visual sensation pure and undefiled as it is in the early years of childhood; let us reduce to vanishing point the interference of the teacher; let us remove from the child's environment, so far as we can, anything which will induce him to copy our adult productions. For we are sophisticated people, and have lived so long that the purity and independence of our two-dimensional visual sensations have been impaired and corrupted by our experience of the world. Set the child face to face with Nature; he can, in very truth, see better than we can.

The argument is good and the inferences sound, but—alas for teachers!—is based upon a wrong foundation. For, in the first place, it is very doubtful whether the classical psychologists themselves thought that they were giving a genetic account. And it is quite certain that, even were the account true for the psychological baby—a wondrous and hypothetical production —still it is not a true genetic account for the school-child. If it ever *were* true for him, by the time the teacher gets him, his visual perceptions are hopelessly corrupted. Even if he ever did, he no longer sees solid things as flat extensions on one plane. He knows they have depth, and he can't see how the depth boundaries are to be represented in the same plane as the height and width at all. What does he do in his early drawings? He just puts in all he can of what he knows about the objects he is asked to draw. For example, he will draw two eyes on the same side of a fish's head; he will draw the top of a box *looking* as big as the front. And when you expostulate with him, if there is a proper relation between you and him, he will justify himself by saying, "The fish *has* got two eyes," and "The top of the box *is* as big as the front." He wants to draw what is there, the make-up of the thing, so to speak, not the two-dimensional visual sensation from the object.

All the talk about visual sensations and images resulting from them, which, of course, would be two-dimensional like the sensations, has been of much dis-service to education because it has been misunderstood. Even Professor Sully's work on children's drawings, most highly valuable as it is, suffers from an attempt to work the results into a scheme of primary sensations and secondary images.

What, then, is really the relevant doctrine? Just this: The pure sensations with which we were once supposed to start are really the last result of a long and laborious analysis. We learn in life, it is said, that things are not what they seem; but what is harder for us to learn is that they "look" like things that we know quite certainly they are not. We must be *taught* to see. Children draw what they know, not what they see. I preached this doctrine in *Mind* a good many years ago; since then, Kerchensteiner, quite independently, has announced the same doctrine, and, later still, a writer in Claparède's *Archives de Psychologie* has arrived at the same conclusion.

Constructive Drawing.—What does all this mean for Manual Training—a poor expression: let us say rather for Constructive Work? It means that a child's early drawings are constructive in their intent; he is not really representing the world in pictures, but rather drawing the make-up of things. He tends to draw them so that they will make; that is what he wants to do. He does not want to draw three-dimensional things in flat space like an artist, but puts together the parts he knows like an artificer. Let him, therefore, begin with construction, the construction and modelling of things, not the drawing of the appearances of things. Let me give an instance of the opposed procedure. For example, to switch the child on to a two-dimensional representation of a box before you let him draw the parts of the box, as they are (he would say) and so that they will make-up (for you can't make things up from mere appearances, at least not in the schoolboy's world) is to confuse him and to delay him rather than to advance his progress.

One further big consideration and I have done. I know the world is not arranged on pedagogical principles. The things we adults make, our furniture, our clocks, houses, engines, are made for our utility and convenience and not for the teaching of children. But children have things too, and buy things, and make things; we should evolve our early constructive drawings from these; for analysis before synthesis is the key-note of both early constructive drawing and constructive work. And above all, we should remember that a child who has only followed directions towards an end he does not foresee, however necessary it may be in Morals, is not receiving that sort of education which enables him, as we say, to "transfer" his knowledge in the fullest way. I do not say he will not "transfer" and adapt his knowledge to other things at all; but he will not do so to the same extent as if he is taught inductively.

Let me sum up. Modelling first, then the analysis of constructed objects, then their synthesis, with drawing of the things as they are (not as they appear) in these two stages, and finally the technical draughtsmanship of the workman. And reverting to my earlier topic, one additional word of warning. "Do not expect children to represent three-dimensional things on a two-dimensional surface—their artistic aspect—without a thoroughness and carefulness of method not in evidence to-day, for method is decried. The children cannot and will not *see for themselves*, as we want them to do, without much help from the teacher. He must not draw *for* them; but, if he is a very expert teacher, not an artist, he can show them how to *find out* what things look like. The psychology which led the teacher to believe that the schoolboy begins with perceptions of three-dimensional things on the flat was wrong.

2. TECHNICAL HANDWORK DRAWING

By G. Gummer

Art Master; Head of the Art Department of a Technical Institute

Drawing is an absolutely necessary aid to some forms of handwork. For this reason it is well to bear in mind that we can approach the subject from two standpoints, viz. the drawing of things (1) as they *are*, and (2) as they *seem*. As has been shown above (*Drawing and Constructive Work*), handwork needs the drawing of things as they *are*. When an object has to be drawn so as to give the exact form of each of its parts for the purpose of making a similar object, certain conventional methods are employed to that end; whilst if the object be drawn as it is seen as a whole, this is an exercise in model drawing, and another treatment is used, the form thus obtained being quite different.

It is nearly always necessary, for the making of things, to give ("set out" is the usual expression) the actual forms of the objects in full size or scale drawings. In the initial stages it is advisable to use objects which may be easily handled, measured, and drawn, not only because this enables the pupil to use his senses rather than his reason, but because for class teaching—and this is assumed throughout—it is impossible to get the pupils placed exactly in front of, or over, one and the same object placed in front of a class. Neither can they, with few exceptions, clearly see all to which the teacher wishes to draw their attention. It will be explained later how this difficulty may be obviated.

Method of Tracing Round.—Now, many objects that are made have three dimensions (length, breadth, and height), and at first difficulty is experienced in getting these clearly understood and expressed. The idea employed to make them clear is but an expansion of that used for the younger children when obtaining the true form of things of one or two dimensions—*i.e.* by drawing along or around them. To make the method still clearer, let us assume that the pupils have reached the stage when it is necessary to introduce the drawing of three-dimensioned objects, which necessarily includes those of one and two.

There is one matter, in itself small, but nevertheless essential to good work, to which it is advisable to draw attention at once. The use of sheets of paper, and not drawing-books, is necessary, as from the beginning T-squares and set-squares must be used. These instruments are most difficult, if not impossible, to manage properly with a book, for our purpose. With so much dependent on accuracy, a flat and even surface is essential. The sole reason for a book, other than that of its cheapness, is to keep a record, in sequence, of work done. The sheets, however, may be always so kept by the use of portfolios or large envelopes. Against this we must set the needs of the pupil, for, beside the points mentioned above, he needs his drawing quite handy, on or near the bench, from which measurements may be taken or read for the actual practical work, and this is also a usual method employed in the workshop in after-school life. Avoid books, therefore, unless they are cut up to make single sheets.

For class work, at this stage, a certain uniformity is obviously necessary; and it is good for the pupil, and helpful to the teacher, to introduce methodical habits from the first. Therefore, let each student pin a one-eighth imperial sheet (11 in. by 7½ in.), as being most useful for the lesson, panelwise on the drawing-board, and draw two faint lines, one horizontal and one vertical, across the centre of the paper as shown in Fig. 1. A chisel-pointed H.B. or F. lead pencil will be suitable for this and all ordinary purposes.

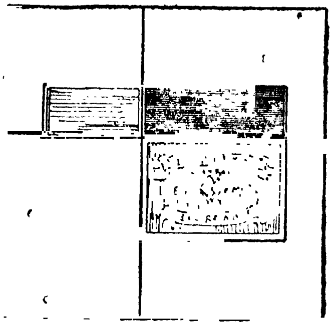


FIG. 1.

An empty matchbox, or similar rectangular article, with which each pupil has been previously notified to provide himself, is placed flat down below the horizontal line and to the right of the vertical, and with the edges just touching in each case. Let each pupil now trace carefully round the face in contact with the paper, and by examination it will be seen that each angle and edge of the upper face of the box fits the form so drawn as accurately as the face in contact. As further practical proof of this, when the box is removed, it will be found, by using rule and set-square, that these two faces and the quadrilateral drawn are similar forms. In other words, a drawing has been made exactly representing the two largest surfaces (length and width) in form and size.

After replacing the box, and using the edge on the line as a hinge, turn the box on its long narrow side, and, after repeating the marking round and examination as before, the pupils have the drawing of two other surfaces, above, and with the lower edge touching, the horizontal line. Similarly, using a short edge of the box on the vertical line as a hinge while in the second position, and by turning on the end adjacent, the drawing of the last surfaces necessary to give all the forms and dimensions contained in the object is obtained.

There are advantages in so using a box of this description, for, while easily handled by each, it is also readily obtainable. Again, the matchbox as a whole may be treated as a solid for drawing purposes; and the case and inside of it, taken separately, introduces the pupil to the setting-out for cardboard work and the developments for sheet metal-work (Fig. 2).

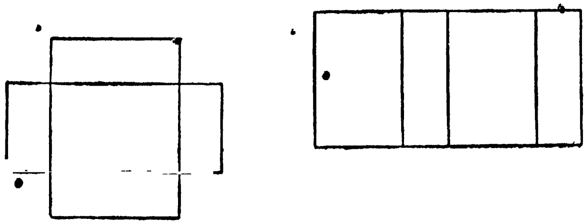
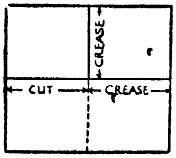


Fig. 2.

Orthographic or Plane Projection.—This brings us to a variety of the above process, which, while containing the same principles and giving a similar result, is that generally used in drawing for bench work.

For class demonstration the teacher will need a double-hinged board and a model. One imperial and two half-imperial drawing-boards, blacked and hinged so as to be used in the same manner as the creased guide paper (to be described below), will suffice for the board. The model should be a box, block of wood cut proportionally, or large cardboard model painted or paper-covered in imitation of a matchbox. The pupils will need to be provided with pieces of stout cartridge paper or cardboard about 6 in. by 4½ in., which they well crease on the horizontal and vertical lines drawn as in the previous exercise (Fig. 1). The paper, below the horizontal line only, is then pinned and the whole smoothed down. The pupils then proceed by placing the box edge on the horizontal line and drawing around as before. This form of the box is seen when looked at from above, and is therefore the "plan," and should be so labelled. While the box is still in position, fold up the paper on the horizontal crease until the part so inclined reaches the vertical. It will be noticed that the shape drawn on this vertical surface—the bottom or base line lying in the crease and terminated by the uprights—is the form seen by looking directly at the box from the front. This is termed the "front view," or more often the "front elevation," for the reason that it contains all the vertical heights in the front view.

In order to complete the orthographic drawing in Fig. 3, a view must be obtained by looking from a position to the right (or left) at right angles to that occupied previously. To obtain this, cut the paper as shown. To draw the form of this end the pupils turn their papers at the vertical crease until they lie against the box (Fig. 3). They then draw around as far as possible, and will notice that the right edge coincides with part of the vertical crease and the base edge with part of the original vertical line below the horizontal. Mark the limits on these lines; remove the box and complete the drawing. This is termed the "side view" or "side elevation." By spreading the paper flat, a representation can be obtained showing the same result as by the first method. This is called a "plane" or "orthographic projection."



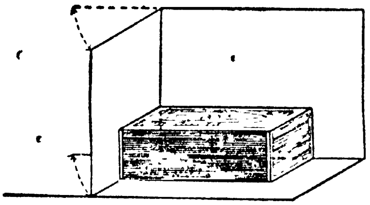


Fig. 3.

It is necessary for the teacher to illustrate operations with his own hinged boards and model, showing how to manipulate the boards during the drawing of the object; and afterwards how to open out the boards so as to show the completed drawing on a flat surface.

For much work, when dealing with objects similar in form and character to the box, the plan and front elevation are sufficient to represent an object, because, by analysis, dimensions shown in the side elevation are given in these drawings.

An examination of the drawings done by either of the two above methods will show that, owing to the circumstances under which the work was done, the lines are not so straight, neat, direct, or accurate as they might be. To rectify this, and as a further step towards the usual method of drawing for making, let each pupil pin the paper for the finished drawing on his board, and prepare a guide paper as before. The horizontal crease is then represented on the prepared drawing-paper by a line ruled horizontally with the T-square. Repeat the various processes as in the previous exercise, and rule the plan with T- and set-square in the same position with regard to the horizontal line, obtaining the various dimensions from the box *in situ*. Proceed in the same manner with the elevation, noting that the side lines of the plan give—when continued upwards to the correct height—the side lines of the elevation. This may not be understood at once, but by folding the guide paper at the crease, and drawing around the elevation and smoothing it out again, the point will probably be realised.

Before drawing the side elevation, and in order to make the matter quite clear, place the folded paper and box in correct position. Next, while looking directly at the box in elevation, move it around on the horizontal surface it stands on—using the left corner of the box which touches the back upright edge as a hinge—until the box is against the vertical surface. It is then seen that the height—which cannot alter while so moving—travels along in a horizontal line to the left (or right), so that, if a line be drawn parallel to the horizontal line on the drawing paper and the height of the elevation, the height of the side view is obtained. By further examination it will be seen that the length is that of the short side of the plan, and is terminated by an upright line. The whole may then be drawn in neatly, and the exercise completed by labelling the several views.

It is often advisable, for various practical reasons, to draw the plan a little in front of the horizontal line, and the side view a short distance left or right of the elevation. This is quite a simple matter, when the above principles are understood (Fig. 4). A constant reference to the guide paper and box will soon convince the pupils that the actual form and size are not altered by the changes of position.

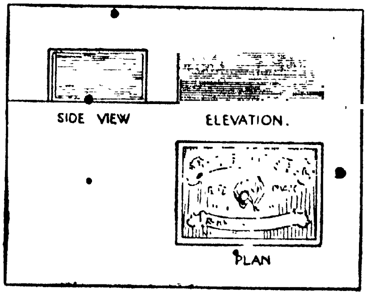


Fig. 4

Unknown to the pupils, they are dealing with the beginnings of orthographic projection, but there is no need, yet, to even mention co-ordinate planes, projectors, traces, or other terms associated with that subject. But whenever an object of three dimensions (length, breadth, height) has to be made, it should always be drawn first by this, or another method of projection shown below, choosing that by which the drawing may be most easily read and understood.

At this stage, then, the pupils have learnt to realise the meaning of, and to draw on the flat, a simple plan, elevation, and side view—that is, the true shape and size of a three-dimensioned object. This method leads to others of more complicated geometrical, and other, outlines.

Scale Drawing.—For many purposes, no matter what the method of projection, it is necessary to draw the objects to scale, that is, all the parts are reduced or enlarged proportionally. The scale should always accompany the drawings, as 1 in. = 1 ft., ½ in. = 2 ft., etc., or $\frac{1}{12}$, $\frac{1}{48}$, etc. This means that 1 ft. (or 2 ft.) on the actual object is represented by 1 in. (or ½ in.) on the drawing, and care must be exercised that this scale is maintained throughout, unless otherwise stated. If in the first instance the teacher's model is made proportionally, say, to six times the scale of the matchbox, it will give ample scope for the satisfactory explanation of the meaning of scale drawing. The boxes may be collected and placed against each side of the large model separately, or the pupils may measure up each edge of their own and compare with that of the corresponding edge of the teacher's box.

Squaring up.—Further, a face—*e.g.* the one containing the advertisement—should be ruled into equal rectangles, by dividing the long edges into, say, four equal parts and the short sides into three, and then joining by straight lines. If the teacher's model is treated in the same manner, he is enabled to reproduce a part, at least, of the forms in the corresponding rectangles on the matchbox to six times the scale. This method is termed "squaring up," and is useful when, later,

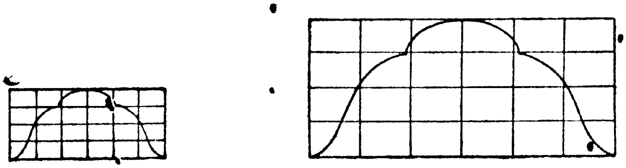


FIG. 5

the pupils will be called upon to reproduce to scale any decorative feature, such as shaped ends or curved work generally, examples of which are shown on the top and bottom of the bracket (Figs. 5 and 9).

Conventional Isometric Projection.—Another method of representation often employed, from which measurements may be taken—and this is essential in drawing for handwork—is known as conventional isometric drawing. It is an adaptation or modification of isometric projection, which is of value to advanced pupils, but is of so difficult and complicated a nature that it should be ignored at this stage. Conventional isometric projection has the further advantages of giving actual resemblance (in the drawing) to the object to be made, in so far as the drawing has a solid appearance—as opposed to that of plane surfaces seen in the previous examples—and also that, with practice, it is readily mastered. As the name implies, it is drawing by equal measures (isometric), that is, the same scale or standard is used for lines on either side of the line representing the perpendicular (in the object) nearest to the spectator in its representation of an object, and no part is foreshortened as in the case of what is usually known as "pictorial perspective."

Without entering into the theory of the subject, it will suffice to say that isometric drawings are based upon an imaginary cube seen from a distance, and that the three surfaces represented have the same area (Fig. 6). It is readily obtained by inscribing a regular hexagon in a circle and joining alternate vertices to the centre. All lines drawn in isometric projection will be parallel to those forming the edges of the cube, as seen by the example (Fig. 6).

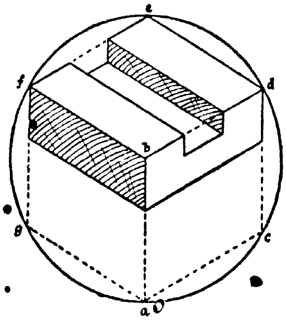
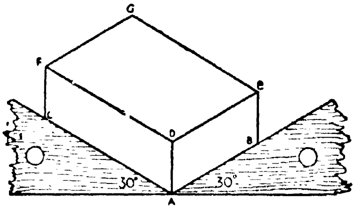


FIG 6

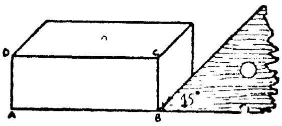
To proceed by this method wholly is at times cumbersome and unnecessary, but by using the 60° set-square we obtain the drawing required more directly and easily (Fig. 7). It is therefore advisable with young pupils to introduce the set-square at once and leave the reasons until they are ripe to grasp them.

The following operations are employed in drawing the object in conventional isometric projection. A horizontal straight line is drawn and any suitable point indicated in it. From this point (A) radiating lines are drawn any reasonable length to the left and right at 30° with the horizontal. A short edge of the large surface of the matchbox is measured and cut off from point A along one of the lines drawn (A B). The long edge is treated similarly and cut off on the other line (A C). From the points A, B, and C, perpendiculars are raised to D, E, and F, either by measuring the height of the box along each and then joining up, or—to keep to the same idea—cutting off the height on A D and using the set-square as indicated above, so obtaining D E and D F. Edges F G and E G are drawn in like manner, thus completing the drawing of the box (Fig. 7). It will be observed



CONVENTIONAL ISOMETRIC

FIG. 7.



HARRISON'S PICTORIAL

FIG. 8.

that the result gives a somewhat distorted form of the model, that is, viewing it as a sketch or perspective drawing; but it must be remembered that the main idea in its representation here is to give in a pictorial form all that is necessary for the making of the object.

Harrison's Pictorial Projection.—Sometimes there are circumstances which make it advisable to use a type of drawing known as Harrison's pictorial projection. Its great advantage over the isometric is found in cases where the model contains circular or other curved work, which presents a somewhat difficult problem when drawing an isometric projection. It is worked as follows: A horizontal line is drawn (Fig. 8), and any point, B, in it is taken as a starting-point for the projection. From B a perpendicular is drawn representing the perpendicular in the object nearest to the spectator. Next the line BA is measured off (full scale) on the horizontal, to represent the bottom edge of the front face of the object. Then from B is drawn a line at an angle of 45° (as shown in Fig. 8), and on it is measured off a length (*half scale*) to represent the lower edge of the right-hand side of the object. The whole of the front is then completed in full scale and the side in half scale. This method is an adaptation from Oblique Projection.

Let us assume that our model is pierced by a circular hole, or has a shaped top. In that case a surface containing the hole as a circle, or the shaping in true form, is used as the elevation. Thus we get the otherwise difficult drawing of these forms presented in the simplest possible way, and, when drawn for making, the most easily read and copied.

Sketching.—The question of the drawing of these forms involves the use of mechanical means for their production in many instances, and the method of squaring up (mentioned above) is helpful in others. The latter, however, often needs the assistance of freehand drawing, and in other cases we are entirely dependent upon it for our forms. It is so essential in handwork that it is advisable to train the power to make clear freehand drawings (sketches) from the first.

The subject should be taken concurrently with what is termed the more mechanical drawing, as the longer it is left the more difficult the power is to acquire. The term "sketches" is not meant to convey a looseness in execution.

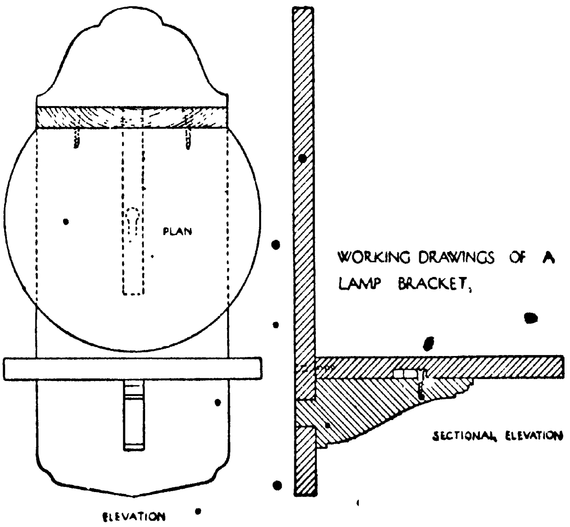


FIG. 9

With young pupils all sketches should be in the nature of careful studies.

The range of suitable subjects is very wide: fashioned objects of all kinds, parts of large objects, etc., and so on, large copies or photographs of these—although care must be exercised in not abusing them by too constant use—and the simpler geometrical solids, containing as they do the principles of many objects of sub-architectural character. Exercise, too, should be given in drawing, say, a piece of wood or metal turning as viewed from the front (front elevation) without measurement. The drawing of these things, and completed practical exercises from memory and dictation, all give valuable training for our purpose.

Among the various types of pupils we find those who possess the natural aptitude for readily representing the object to be drawn and others who cannot do this with facility. Greater help may be given individually in the latter cases. Upon the pupil showing the best he can do in the way of a representation of the object, say a box placed some distance away, a sheet of glass is held upright at arm's length between him and the object. He should then draw the box on the glass, and afterwards compare and analyse his two drawings.

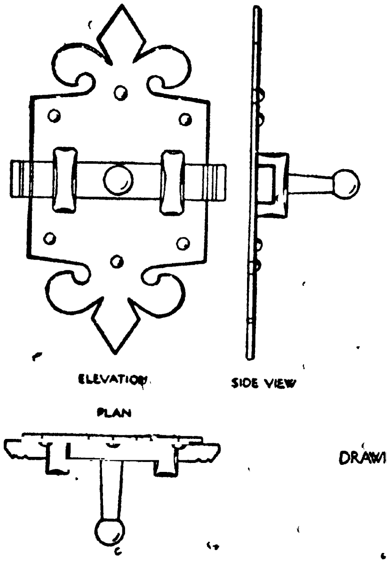
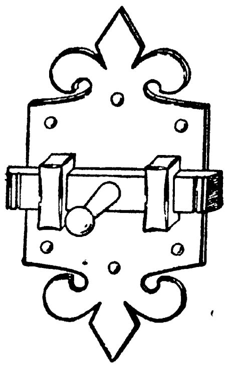


Fig. 10



DRAWINGS OF A WROUGHT IRON BOLT.

Fig. 11.

Where examples of shaped work or the turning mentioned above are drawn, the pupil should test the accuracy of his work by the use of rule and calliper, or, if necessary, by cutting out his drawing as a template and comparing it with the form represented.

So far, we have dealt with the subject of this article by tracing, plane projection, conventional isometric projection, Harrison's projection, scale drawing, squaring up, and sketching. As an aid to explanation a simple object, a matchbox, has been used throughout; but the representations given of the wrought-iron catch and the bracket show these principles applied to more advanced form.

A Workshop Drawing.—Fig. 9 is a correct working drawing—such as is actually used in workshop practice—applied to a simple object. In such a drawing the sections of the plan would be hatched with blue pencil, the sectional elevations with red pencil, and the remainder drawn with ordinary blacklead pencil.

BOOKS FOR REFERENCE

T. S. USHERWOOD: *Practical Drawing* (Macmillan). HENRY J SPOONER: *Industrial Drawing and Geometry* (Longmans). F. STURCH: *Manual Training Drawing* (Methuen).

LI. BOOKBINDING FOR SCHOOLS.

By John R. Brown

Formerly Headmaster of the Irthlingborough Council School, Northants; Manual Training Woodwork Certificate, City and Guilds; Art Class Teacher's Certificate, South Kensington, etc.

Its Educational Elements.—Bookbinding helps to train boys and girls in many good and useful habits, *e.g.* using their eyes, thinking before doing, patience in the doing, cleanliness, accuracy, pride in work. It also teaches respect for books, as objects which have taken skill of hands and minds and much painstaking effort to make.

The best of the educational value of the art will be lost if the teacher takes an undue share in the work, instead of getting the pupils to use their own eyes and brain. What wants doing, and what tools to use, and the why and wherefore, must, as far as possible, be got from the pupils after they have observed and inspected work done by the teacher, step by step. This may be slow work at first, but after a course of woodwork, etc., the pupil should soon make rapid progress and get more and more interested.

The connections of the subject with the pupils' home life through their own books, and with school life through its many books, are too obvious to need comment. Like other handwork subjects, educational bookbinding serves as a preparation for a vocation, and may decide the choice of a calling. It is also a most interesting, attractive, and valuable hobby.

When to take Bookbinding.—It is best to take this subject after wood and metal work, as the pupils must know how to use and how to sharpen cutting tools, if they are to make their own frames, etc. Pupils should, as a rule, be about ten or eleven years of age before beginning this work.

Scope.—The following notes on Bookbinding will only refer to simple work for elder scholars, and not go into the full craft of the professional bookbinder. When the pupil has thoroughly mastered these instructions, and wishes to turn out better and more advanced work, he must use his eyes in passing book-shops, borrow from the Public Library up-to-date books on the subject, or, better still, attend classes where the work is taught. He will need to spend only a few shillings on tools.

Tools and Materials.—Some of the tools required are to be found in the ordinary home, and the others are not very costly, except the iron screws, which can be bought from the ironmonger. "Why iron screws," you will say, "when the professional uses wooden ones?" For this reason: that having bought the screws, you can prepare the wood and fix the screws in the Manual Instruction Room.

The few tools and materials will be: a tenon saw, shoemaker's knife and hammer, bodkin, strong paper-knife, nippers, piece of zinc 4 in. × 2 in., paste brush of hog's hair string bound, smaller one for glue, white paste made of flour and alum 32 to 1, Scotch glue, or dextrine instead of paste, a little oil of cloves in bottle for the dextrine, two 1-pint jam pots, one curtain-pole ring the size of bottom of jam pot, piece of hardwood for knocking up (or mother's flat-iron), one reel of No. 10 white cotton thread, a 2-in. darning needle, ball of three-strand cotton string, T-square, rule, pencil, scissors, saucepan for glue pot, two smooth box lids for cutting boards, millboard for covers, smooth brown paper, cloth for covering (such as green window-blind material), gold bronze powder with medium and pencil brush, two cheap tooth brushes, a bottle each of red and green ink, and sheet of drawing paper for fly-leaves.

Preparation.—Beginners should not attempt to bind a thick book at first, but only such as *Woodwork* or any book with not more than 624 pages. The following processes are necessary as the preparation for binding proper.

Cleaning.—Before pulling the weekly or monthly, etc., parts to pieces, the leaves should be cleaned. This involves examining each leaf for finger marks, stains, tears or creases. Dirt and finger marks may be got rid of, to a great extent, by using stale breadcrumbs, but not rubber; stains by washing carefully with warm water; grease with blotting paper and hot iron; creases by rubbing down with paper-knife.

Mending Tears.—Tears require very careful handling. Do not use dextrine or glue, but take each tear and mend it by laying the leaf on a clean piece of paper, to see if the edges meet touch the edges with a finger-tip which has been slightly smeared with paste; draw the edges together and cover with transparent tissue paper (bought from a dealer). Then turn over and serve the other side with the tissue paper. Allow a little time for drying, and then tear the tissue paper away. Half leaves or places may be given a $\frac{1}{8}$-in. margin of paste on the back edge on the underside, place in position and smooth down with clean paper-knife.

Pulling to Pieces.—Having got all the weekly, etc., parts clean and in order, turn the lot upside-down; take the last part, tear off what is not required, and place that part face upwards. Continue this work till the first part is reached. Now take the lot again and place face downwards; get hold of the first part, but this time open it in the middle where the staples are found; lay the section flat on the table on its back, and with the dull blade of an old pocket-knife or thin back edge of the large shoemaker's knife lift the tip of each staple upright, as in Fig. 1.

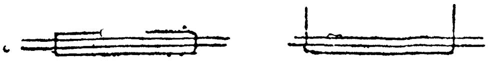


FIG. 1

Next close the book, hold it tight with the left hand, and then, with the flat-nosed nippers, old knife, or thumb and finger nails, pull out the staples squarely. The reasons for pulling them out are: they will not be required, would ruin the tenon saw, would get rusty and unsightly. In doing this do not disturb the position of the leaves. Place this section face upwards on the table and repeat the process for each section. Look out now for title-page and index, which are generally found in the last issue; place title-page in front and index at end, and add the double leaf of drawing paper.

Examining.—After this take the book in the left hand, by the back, and open with the right hand, allowing the leaves to fall one by one on the left wrist, so as to see that all the leaves are in order.

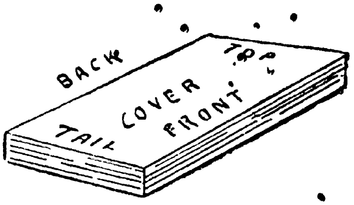


FIG. 2

Binding a Thin Book.—*Terms Used.*—Look closely at Fig. 2 for terms used. The back is where the staples were; the top is the head of page; and the tail is the bottom of page.

Knocking Up.—Grip the back edge with one hand and the front with the other, and gently knock the top edge on the table till all the tops are level and square. When satisfied, get hold of the bottom and top and knock the back on the table, keeping the top edge square. It may be necessary to repeat this process before all the backs are up. Next place the book very carefully between the cutting boards, allowing the back edge to project about ½ in. beyond them; take off the top of press and place the book and boards on the bed of press; replace the top, washers and nuts; and screw up with the wrench. Be sure the back is square and all the sections up, or one may be missed in sawing. If the worker's hands are strong and large enough to grip the book with boards, he may put his work in press without taking off the top. The book and press should appear as in Fig. 3.

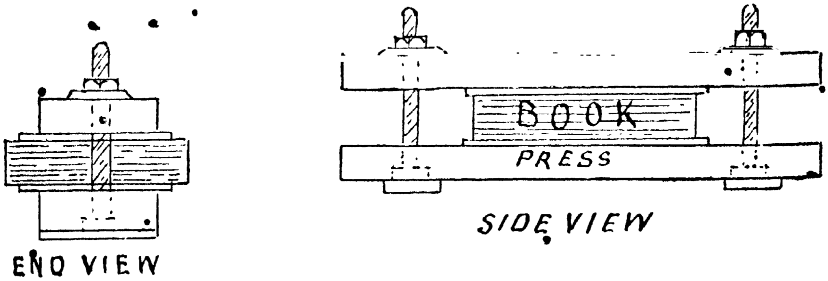
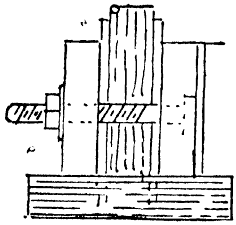


FIG. 3

Sawing.—Pack the ends of the press with books to keep the front edge of book off the table (see Fig. 4). Take the T square, soft pencil, and rule. Square lines across the back for saw cuts, but before doing this decide how much of the bottom edge of book is to be cut off, taking care not to cut off any more than is neces-



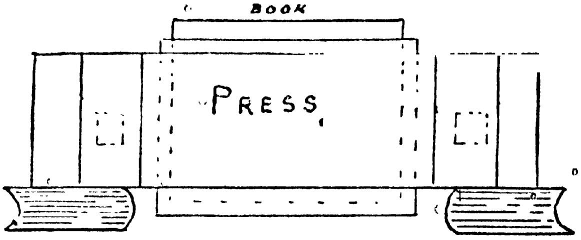


FIG. 4

sary. Make a mark, and then, $\frac{3}{8}$ in. from this mark and $\frac{3}{4}$ in. from the top edge, draw two lines across for what is called *the kettle* or *catch stitch*. The space between the kettle stitches is then divided into equal spaces according to the number of cords to be used, say three, in which case four spaces are required (see Fig. 5). Next grip the back near the lines with the thumb and first finger of left hand, and with the tenon saw, cut the lines about $\frac{1}{16}$ in. deep—if deeper, the cuts will show when the book is opened.

Sewing.—We are now ready for the stitching. Take the book out of press, blow off any odd pieces of paper, and place your book face downwards on a piece of clean newspaper on the table, near the back left-hand corner of frame. Prepare the frame by lowering the bottom nuts as far as possible, to allow the horizontal bar to get to its lowest level. Cut three pieces of string from the ball for lay cords, allowing 8 in. longer than the distance from bar to bottom of frame; make a loop at the end of each cord, or tie one end of each cord to the short iron skewers called keys; push each key through slit in bed of frame; turn the skewers across the slit at right angles, placing the other end of cord over the bar, and loosely tie.

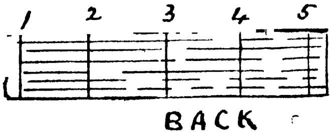


FIG. 5

Next get the fly-leaf of drawing paper; turn it over and place on bed of frame; close up to the cords, arranging the cords to come into 2, 3, and 4 saw-cuts and to stand vertically; tie tightly each cord to bar; loose the top nuts; lift up the bar with left hand, and at the same time turn the bottom nuts to

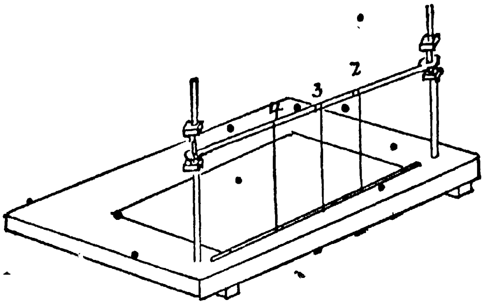


FIG. 6

follow the bar with the right hand, when the cords should be as tight as fiddle strings. Frame, fly-leaf, and cords appear as in Fig. 6.

Now sit near the front left-hand corner; take a No. 10 reel of cotton and the short darning needle; cut off about one yard of cotton; take the twist out of it by drawing it between the finger and thumb; thread the needle; put your left hand round the left-hand pillar into the middle of section to be sewn; push the needle point first through No. 1 saw-cut, catching the middle of the needle with the left-hand fingers; pull a few inches of thread through the cut, and then push the needle through No. 2 saw-cut, coming out on the right of the cord; pull the needle and thread with right hand till about 6 in. of thread is left projecting from No. 1 cut; push the needle through No. 2 saw-cut again, but this time on the left of the cord (Fig. 7), the thread going round the cord on the outside; repeat at each cord till you come out at the last saw-cut, No. 5.

With finger and thumb nails push the thread down the cords, and push down the section with the paper-knife; get hold of thread at both ends and pull tight; place the next section on the first, but take the needle through No. 5 and round the cords, coming out at No. 1; tie the loose end, left at No. 1 previously, to the thread that has just come out; cut off the short end not required; press down the section, and repeat the process as for section 1, coming out at No. 5. It is wise now and again to tilt the frame to see that no loops or slack threads are left in the middle of the sections.

Kettle Stitch.—We now come to the first kettle stitch, which is really only half a knot. Draw the needle under the 2nd section;

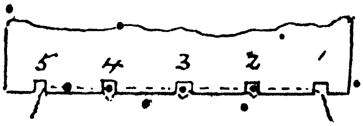


FIG. 7

push it out near the left pillar; draw the thread till only a small loop is left; pass the needle through the loop; press down the section (but not too much) near the kettle stitch; pull with right hand till loop closes.

From Fig. 8 it will be seen that the 3rd is tied to thread going from 1st to 2nd section. The next kettle stitch is made at No. 1 cut, and so on till all the sections are fastened together; but finish off by making two or three stitches, one below the other, at the last saw-cut. As the thread must be in one continuous piece, when the needleful is finished, another is to be tied to it, in the middle of the section between the cords, by a weaver's knot.

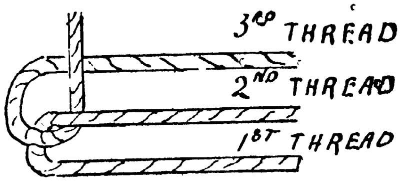


FIG. 8

Weaver's Knot.—To make a weaver's knot, turn the frame round. Take the old end between first finger and thumb of the left hand; pass the new end under the old end; twist the thread round the first joint of thumb, passing the thread under the new end, over the old end; then pass the old end through the loop with right thumb, grasping the end with the left thumb and finger; thus two loops are made; pull the new piece till the loops close; cut off spare bits (Fig. 9).

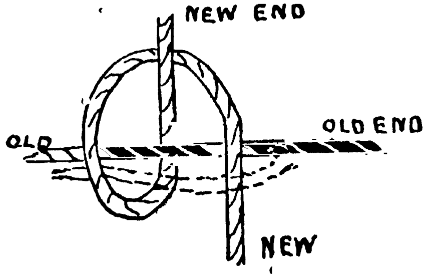


FIG. 9

Gluing Up.—Having finished the sewing, cut the lay cords about 2 in. from the book, drawing out the skewers carefully or they may pull the cords out. Place the book again in the boards after knocking up; then place it in the press, with a piece of newspaper on each side between book and cutting boards, allowing the paper to project about 2 in. round the edges. The boards should extend about $\frac{1}{8}$ in. beyond the back of book. Knock up if required and screw up slightly, but not so as to crease the back; pack the ends of press again (Fig. 4);

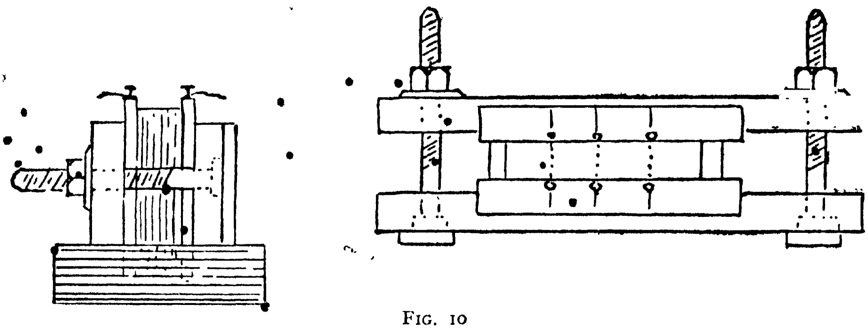


FIG. 10

bend the papers and cords over the cutting boards, and fasten with drawing pins (Fig. 10).

Put as much broken glue as it is thought will be required in one of the jam pots the night before it is to be used; cover the glue with water, and allow to soak during the night. Take a saucepan, fill it about one-third full of water, and drop in a wooden ring or pieces of coke for the jam pot to stand on, in order that the glue may not be burned; stir the glue with a flat stick occasionally; leave the stick in the glue, but not the brush. The melted glue must be thin. Go over the back of book with the hot glue, working the brush well in the saw-cuts; and then allow it to dry. When dry, take it out of the press. The papers mentioned above are used to keep the glue off the boards and the fly-leaves from sticking to the boards. Now strip off the newspapers and any loose glue on the cords with finger tips.

Cutting Edges.—The book edges must now be cut, and as it is only a thin book, a large knife or chisel may be used; but whichever is used must be sharp. Place the book flat on the table and mark on the fly-leaf what it is intended to cut off,

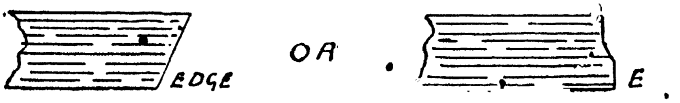


FIG. 11

using the T-square and squaring from the back. Place the book between cutting boards, one the full width of book, the other

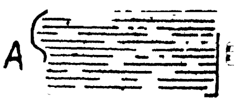


FIG. 12

up to the headline; then, in the small press, cut the head first, then the tail, and in using either knife or chisel, take care that it slides along the top board vertically—to secure this look steadily: 1st at the back of the knife, and 2nd from an angle of about 60° looking side ways. Cut two or three leaves at a time. Do not cut the edges as in Fig. 11. All must be cut square, or it may be necessary to recut a part and trim up with chisel and sandpaper. Also care must be exercised in screwing up, so as not to get a creased back at A (see Fig. 12).

Paste or glue a narrow strip of waste covering cloth or brown paper the full width of back between the kettle stitches (as in Fig. 13), to strengthen the back. A and B are the kettle stitches.

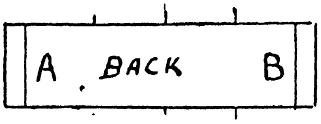


FIG. 13

Covering Cords.—When dry, cut off the lay cords to about 1¼ in. from saw-cuts. Get your finger and thumb to work and untwist the cords up to the saw-cuts; bring the back towards you, and with the bodkin, separate each strand into threads. Place the piece of zinc on the book, with one of the bunch of strands fitting in the notch, and with the knife scrape the ends of the threads (Fig. 14), but do not cut the threads. The scraping is to allow the threads to lie flat on the covers, and will scarcely be seen when the covers are in position.

The professional bookbinder threads the cords through two holes (for the end of each cord) pierced in the millboard with the bodkin; cuts a channel for the cords to lie in; then knocks up each hole with the hammer, and cuts off what projects beyond the holes.

Millboard Covers.—Prepare the millboard covers by cutting the size required, or allow a little extra, which must be cut off just before covering with cloth. If the boards are too thick, the three edges of each

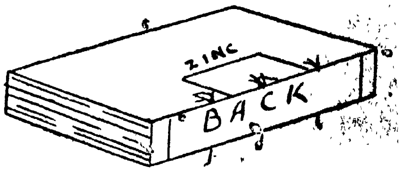


FIG. 14

may be thinned down with the knife and file. While the glue is getting hot, prepare two strips of brown paper 2 in. broad and the full length of book; turn the front edge of book towards you; push one cover under the cords, close up to the saw-cuts; turn the cords backwards; draw the glue brush along the edge of millboard, making a width of 1½ in. covered with glue; push each group of threads on to the patch of glue with the bone knife; spread out the threads, keeping the board in its position with the left hand; stroke down the threads, go over them again with the glue; place on the brown-paper slip; well rub down with knife. Serve the other side the same. After this place sheets of newspaper on the covers and the cutting boards and weights, and leave them there till the glue is dry.

Cloth Covers.—Get the table ready by placing on it a good piece of clean oilcloth, larger than the open book. Have a damp sponge and dry cloth handy for wiping the fingers, which must on no account convey to the edges of book any paste, glue, or dextrine. Lay the covering cloth flat on the table; cut to size, allowing a ¾-in. margin all round for turning over the edges of millboards; double the cloth to get the centre of book back; make a crease; open it out again; paste all over the face of it. If dextrine is used, it ought to have been made the day before it is required for use. Whilst this adhesive is sinking into the cloth, rub your brush under the loose edge of brown-paper slip, and rub down; wash the left hand; place the back of book along the crease mark, holding the book with the left hand—gripping it with first finger and thumb inside the covers, little finger outside one cover, the second and third outside the other cover (Fig. 15).

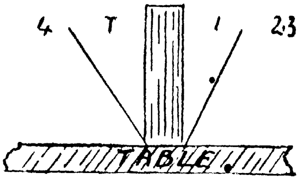


FIG. 15

Rub the paste brush over the right cover; lift up the cloth to the cover; press it home; turn the book round. Serve the other cover similarly, but do not loose the grip with the left hand, only changing finger hold—thumb, third and fourth fingers outside covers, first and second inside. Place the book on the table, and well rub down, but see that the margins of cloth are right in width. The rubbing must be done from the back, getting out any air blobs. Get hold of the book again by holding the thumb on one side—inside the boards—and the fingers on the other inside, allowing the boards to fall flat on the table. Rub the paste brush along one long margin of the cloth and also along the edge of covers; turn the cloth with right hand over the edges of covers, tucking it up under the back to the kettle stitch; thus strengthening the back hinge without cutting the cloth. Turn the book round, but do not loosen the grip. Serve the other margin similarly, rubbing down in both cases with knife.

Having finished the top and bottom edges, turn the book half round and serve the front edges in the same way. In this case there are two corners to contend with on each cover, and these may either be tucked under the millboard or cut for a mitre, pasted and well rubbed down. If the millboards are the same size as book, the pasting may be done inside the cover. Raise the cover and close that side of book; serve the other side the same; place the book flat on the table and spend a little time in rubbing down.

Place a piece of newspaper on your drawing board; then the book on it; cover with another piece of paper; then cover with the cutting boards and weights. Leave till morning, when the newspaper can be pulled and washed off with the help of a damp sponge, thereby cleaning off any trace of paste that may have soaked through. A few drops of oil of cloves put in dextrine will keep it in good condition for the next job.

Colouring Edges.—For the first book the red ink may be used for the edges. Get two pieces of newspaper 4 in. longer and broader than the covers, and put these between the fly-leaves; turn the margin over the edge of covers (Fig. 16). Place the book in the press between the cutting boards; get the tooth brush, saucer, and red

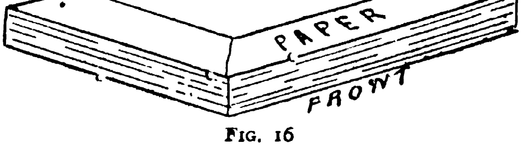


Fig. 16

ink and go over the top edge from the back, then the tail, and last of all the front edge; allow a few minutes to dry; take out of the press. Take care that the book is well pressed, and do not use too much ink.

Lettering.—We are now ready for the lettering. Place the book on the table or in the press with the back towards you; get a soft pencil and faintly sketch the title on the back; with a steady hand, and not too much or too thick gold paint, print the letters according to taste (Fig. 17).

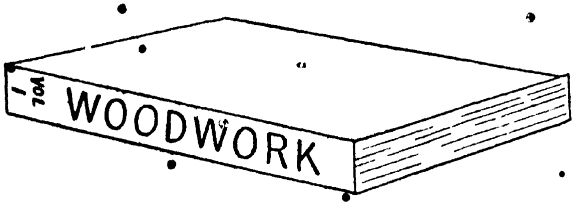


FIG. 17

Binding Thicker Books.—*Collecting.*—For binding a thick book, tapes are used instead of cords. Having got the whole volume, arrange the parts according to issue; take off the covers and what is not required; carefully separate each section with paper-knife; take out all the threads and pick off the glue at the back, being careful not to tear the paper; well rub down the back of each. Any single leaves or plates should be pasted in as described above. Collect the sections in one part and place them under a cutting board and weight whilst doing the second part, and so on to the end.

Tapes.—When the whole of the above is finished, and well pressed, get the sewing frame ready; push the ends of tape through the opening in frame; stick a drawing pin in each tape under the frame, as the skewers are not required. Pass the other ends of the tapes over the bar and pin them tight with an ordinary pin (Fig. 18). Place in press; and mark the position of tapes on the back of book by ruling lines close to each side of tapes and for kettle stitches, using the tenon saw only for the kettle stitches.

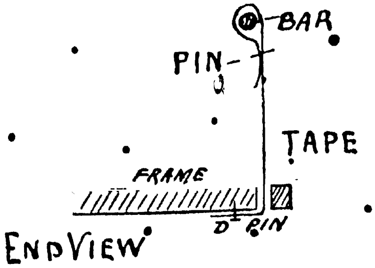


FIG. 18

Sewing.—Commence as before with the fly-leaf, but having passed the needle through the right-hand saw-cut, the needle must come out point first at the line made, then round the tape and in again at the next mark, the thread being kept tight. Go over each section, making the usual kettle stitch; press down the sections; on the fourth section pass the needle under the three threads at the back of each tape; tie a knot before going round the tape and in at the other mark; and so on every four sections till finished. More care will be required in the knocking up and pressing with this book.

Mounting Press.—A stronger press and a plough are required for larger books. Mount the press on two soap boxes (Fig. 19). Mark the fly-leaf as for smaller book; place the book in the press very carefully, the left cutting board being level with edge of book whilst the right-hand board is up to the line on fly-leaf and level with top face of press; cut the top edge first, with the back of book facing you, then the tail, and last of all the front.

Placing Book in Press.—Much patience is required in fixing the book in the press, as it may keep slipping down during screwing up with the right hand. It is helpful to draw a damp sponge over the cutting boards before placing the book in the press (see Fig. 19). Two pupils will be

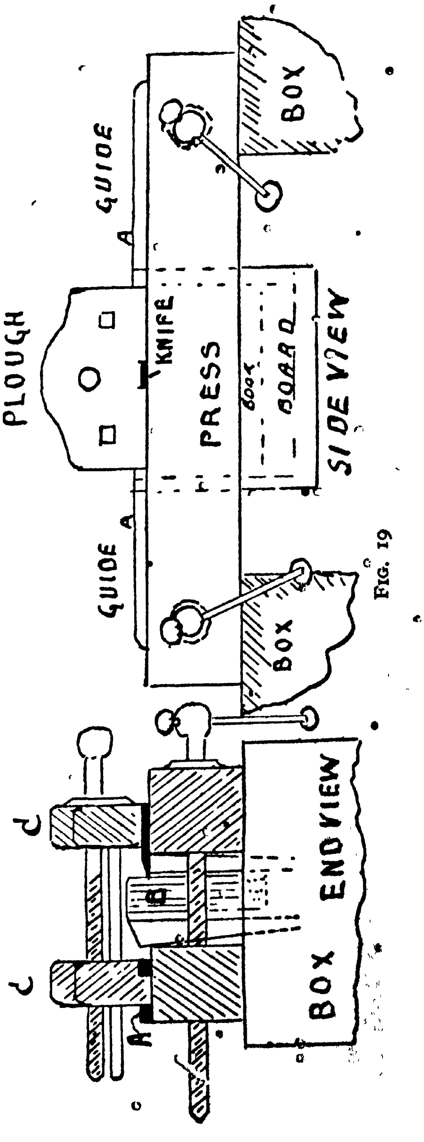


FIG. 19

required for this job, one to hold the book and the other to screw up. See that the knife is sharp, and lying flat on face of press, and screwed up tightly in the plough, or the cut will not be perfect.

The Plough.—The left sole of plough slides between the guides of press; grasp the plough firmly with both hands, the left hand on the left of screw, and the right hand on the head of screw; push it away from you with a forward and downward pressure, turning the screw slightly with the right hand so as to cut three or four leaves on the outward movement, but not on the inward journey. If the plough is in good order and there is no effort to try to cut too deeply, the result will be a smooth square cut. Do not rush the work, or the whole machine may tumble over and jagged edges be caused. When turning the book round, grasp the book and boards under the press; unscrew slowly and place them on the table; rearrange the boards and cut the tail.

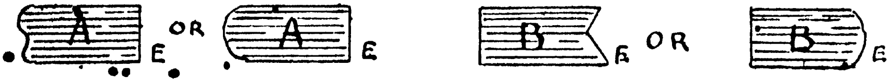


FIG. 20

It may now be necessary to re-sharpen the knife of plough. Put the plough on its back on the table; take out the two screws, and sharpen. The front edge may be more difficult to fix in the press, but whatever is done it is most important not to have a crease or a swollen back (as in Fig. 20A), or the appearance when the back is knocked up will be as in Fig. 20B.

Rounding Back.—Take out of press; damp the glue with a sponge; allow it to soften, but not to get so soft as to stick to the hammer; place the book flat on the table with front edge towards you; then, with the hammer, round one side of back—this may be commenced with the fingers of right hand, keeping the left fingers on the cover and using the thumb to push the front edges away so as to correspond with the back. Turn the book over and serve the other side in the same manner, getting a good round back and smooth hollow front. Put the book into the bevelled edged cutting boards and press (Fig. 21). Screw up very tightly; pack up the press if it is the small one; then with the hammer start in the middle of one side of the back and keep gently tapping towards the ends till the back lies on the bevelled boards (Fig. 21).

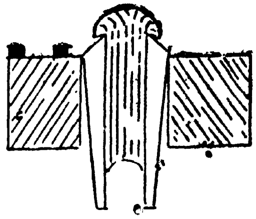


FIG. 21

The face of hammer must be brought fair and square on the book back, or the back may be damaged. The groove formed is for the millboard to work against, consequently the size of it is regulated by the thickness of millboards. Glue a strip of cloth covering up the back, covering only the arch; and allow glue to get hard and dry before taking out of press.

Covering.—Cut the millboards the size required; cut the tapes to within 1 in. off the book; place a 1½-in. strip of brown paper, previously glued on one side, under the tapes; smooth down the tapes with the knife; run brush over the tapes; place the millboard carefully in its place; rub down; turn the book over and serve the other side similarly. Allow the book to dry under weights. Glue a piece of waste cloth between the kettle stitches covering the back and ¾ in. down the margin of millboards, so as to form another hinge and strengthen the back.

Cloth.—The cloth for back may be bought at the dealer's to suit individual tastes, and it is well to get some figured paper for extra fly-leaves at the same time. The cloth is put on in the same manner as with lighter books, except that the corners are mitred, allowing for thickness of boards and lapping over (Fig. 22). Well rub down the part turned over.

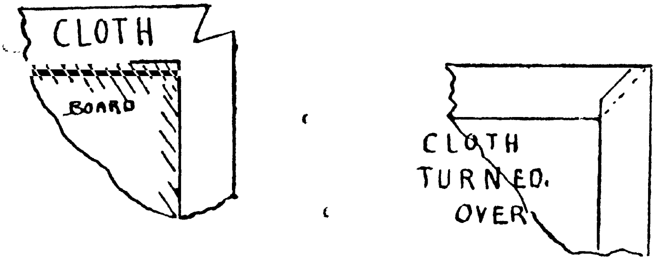


FIG. 22

Fly-leaves.—Make the fly-leaves now, unless bought ones are used, by pinning a sheet of newspaper on the door or table;

then over this, pin the paper to be coloured; get ready the piece of zinc, red ink, brush and saucer; hold the zinc in the left hand and push the brush over the edge of zinc, when a fine spray will fall on the paper. Do not use too much ink on the brush or a blot or two of ink may get on the table and so on the fly-leaf. Allow it to dry; cut to size required; paste a ¼-in. margin on back edges, when doubled; gently tuck the paper well up to the saw-cuts; allow it to dry and then paste the fly-leaf on the millboard side, and close the book.

Marbling Edges.—When dry, put the book in the small press, with paper guards as before; spread a few stale breadcrumbs or rice on the edge to be coloured, and spray the red ink as for fly-leaves; then spray the green ink; blow off the crumbs; if the whites are too glaring, spray again over the whites.

Lettering.—As with the smaller book.

Making of the Tools.—These may be made by pupils who have had some training in woodwork and metal-work (Fig. 23).

Bodkins.—Get a strong darning needle; grip it with the nippers below the eye; place the nippers on the bench, and give the eye a sharp tap with the hammer. Prepare a handle; bore a hole for the needle with a bradawl in the small end; place the needle point downwards in the vice, and knock the handle on to it.

Skewers.—Get a piece of strong wire 12 in. long and cut off 4-in. lengths with a file; bend one end of each to form a ring (this may have to be done with the aid of the fire and nippers). Or get a few iron skewers and cut them to 3-in. lengths. But in either case take off the sharp edges with a file or stone.

The Zinc.—Get a piece of sheet zinc 4 in. × 2 in.; cut or file a notch in one of the long sides; round off the corners, and then rub each edge on a stone, but not the whetstone; clean up with emery-cloth or glass-paper.

Folders.—Get a thin piece of hardwood 8 in. × 1¼ in., and carefully plane it up, with bevel edges; round off the ends; file and clean up with glass-paper to a good polished surface.

Knocking-up Blocks.—Get a piece of hardwood, beech if possible, 8 in. long and 2 in. square, and truly plane up all sides; take off the sharp edges with file or smoothing plane; and finish with glass-paper. The top face may be made round.

Cutting Boards.—Four cutting boards should be made, of beech if possible, without shakes and a little larger than the book to be bound. One set should have square edges and the sides parallel, or the same thickness throughout; the other set to have bevelled edges on one side for knocking up the back of books (see above): to be planed down on one side from the full thickness to half the thickness, and cleaned up as the other tools. The bevelling of the sides is rather troublesome, for boys, so as to get a nice surface.

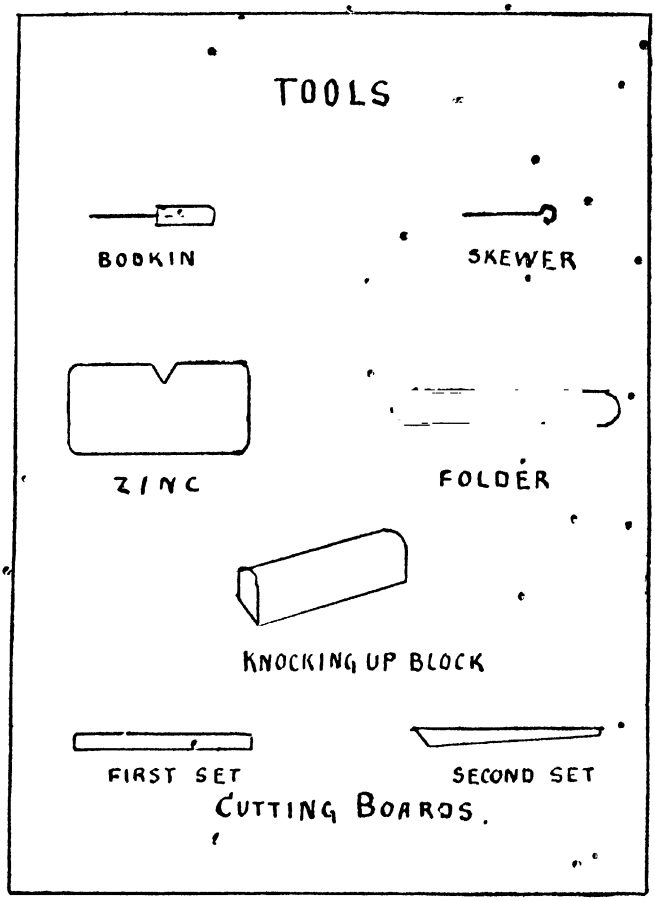


FIG. 23

Making a Small Press.—Plane up two pieces of hardwood, or good red deal, 2 ft. long, 5½ in. broad, and 1½ in. thick; take off the sharp edges, and finish with glass-paper; make two battens of 1-in. stuff, 5½ in. long and 2 in. broad, for feet and to cover the bolt heads (Fig. 24).

Bolts.—Get two 8-in. bolts ⅝ in. diameter, with square heads, nuts, and washers, the threads to be 3 in. from the head and as coarse as possible. Also get a wrench to fit the nuts; the nuts to be an easy fit, so that they can be tightened up with fingers only. Draw a line down the middle of one piece of wood, and 3 in. from each end mark the line; then, with the brace and ⅝-in. bit, bore two holes, one in each end at the cross marks for the bolts—the brace must be held vertically. Cramp the other board to the first, both edges being close and square; mark that board with the same bit; uncramp the boards, and then with a larger bit bore holes through the top piece, to be an easy fit for the bolts. Try the bolts, and run pencil round the square heads on the under side of bottom board; mortise square holes to bury the heads; put in the bolts; nail on the battens—then the bolts should neither turn round nor drop out (Fig. 24).

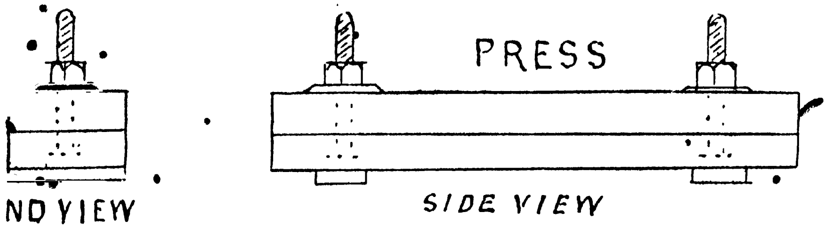


FIG. 24

Making a Sewing Frame, A (Fig. 25).—*Wood.*—This requires a piece of well-seasoned American white wood or good deal without knots 18 in. × 11 in. × ¾ in., and two pieces 11 in × 1 in. × ¾ in. for feet or battens. Clean up the large piece on the top very smooth.

Slit.—Cut a 12-in. slit or groove, ¼ in. broad and ½ in. from the front edge, for cords or tapes to go through—this slit must be clean and smooth. Take off all corners and edges and finish the top with glass-paper.

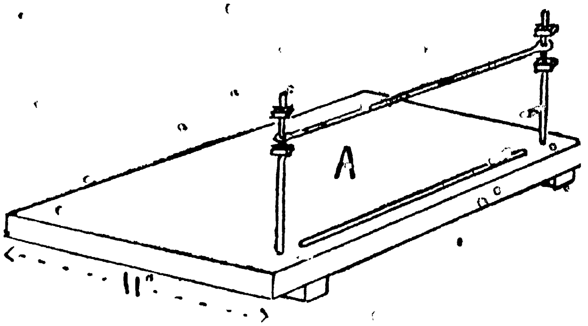


Fig. 25

Bolts.—Get two 9-in. bolts, ⅜ in. diameter, square heads, and four nuts to fit easily; with a ⅜-in. bit bore two holes in board 1½ in. from each end in a line with the slit; drive in the bolts; mark for square holes for heads of bolts; take out the bolts and mortise the holes; once more drive in the bolts and nail or screw on the battens over the bolt heads.

Bar.—From a ⅜-in. iron rod get the blacksmith to flatten the ends and drill a $\frac{7}{16}$-in. hole in each end; the rod is for the horizontal bar and must be an easy fit. Screw down one nut on each pillar; drop the bar on the pillars; and screw on the other nuts to keep the bar from being lost. The frame should appear as in Fig. 25.

Another Form, B (Fig. 26).—This is made without iron bolts, and each boy should have one for himself at home. The bottom board is made as in Fig. 25 A, but instead of round holes for pillars, mortise two square holes for tenons of pillars, but remember the horizontal bar must be vertical to the slit in frame.

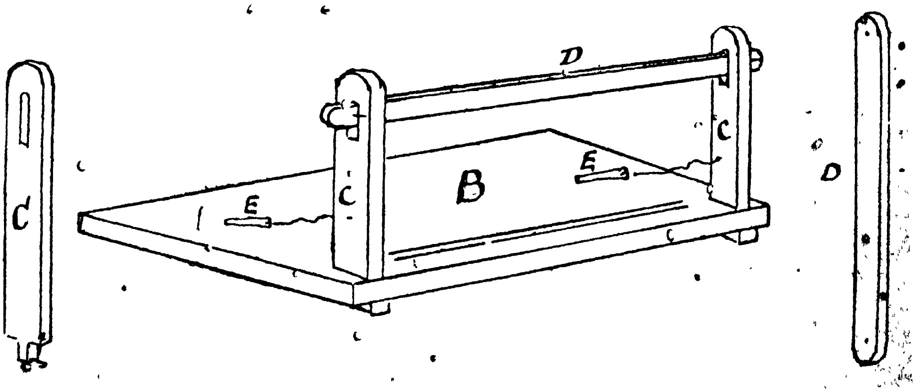


Fig. 26

Pillars.—Prepare two pillars (as Fig. 26 C), 9 in. × 1½ in. × 1 in. with tenons at the bottom, and 2 in. × ½ in. mortise holes 1 in. from the top, taking care that the tenons are a good fit in the square holes. Wedge up the tenons in the holes.

Bar.—Plane up a piece of hardwood for the bar 1 in. × ½ in., and round off the top and ends. The bar must be 2 in. longer than the distance from the outside of the pillars —that is, it must project 1 in. outside each pillar (Fig. 26 D). Make two hardwood wedges (Fig. 26 E) to fit under bar in the 2 in. × ½ in. holes, and bore a hole through each wedge and tie to pillars.

Wedges.—The wedges are for raising the bar to tighten the cords. Cut off the heads of two French nails; round the ends; bore two holes in bar, one on each side of pillar, and drive the pins in the bar. String and pins are only to keep the pieces from being lost.

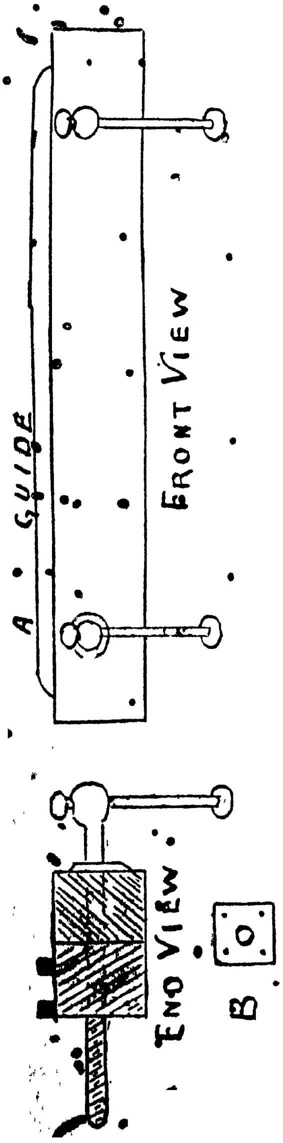


FIG. 27

Making a Large Press.—Procure a good piece of sound beech 6 ft. long, 4 in. × 3½ in. Plane up square on all sides; cut it into two pieces 3 ft. long; square the ends, and take off sharp edges.

Guides.—Make two guides or runners 2½ ft. × ¾ in. × ½ in., and fix with screws (Fig. 27 A).

Screws.—Get two iron screws 14 in. × ¾ in., with square threads, nuts, and handles; 4 in. from the end of each large piece of wood bore holes for screws to slide in and out easily; put the two pieces side by side, push the screws through the holes, screw up the nuts and mark position of nuts on the outside of the left-hand piece of wood with the guides; mortise holes for the nuts, and fasten the nuts in the wood. If the nuts are in the plate form, with screw holes, this is easily done; but if the nuts are square, it is necessary to get two plates made of iron, larger than the nuts, with a large centre hole and four small counter-sunk holes for screws (Fig. 27 B).

Give the press a few coats of raw linseed oil. Soft soap and blacklead may be used for the screws.

A Plough.—Get two pieces of sound beech wood 8 in. × 3½ in. × 1¾ in. Plane up, and make them the shape of Fig. 28 C, and rebate the left sole to slide along the guides of press (Fig. 27 A).

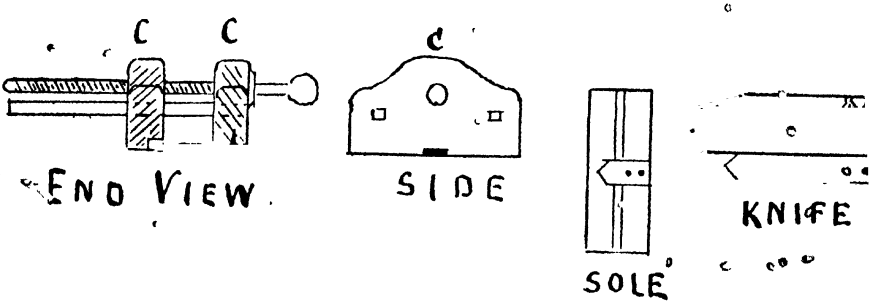


FIG. 28

Runners.—Prepare two pieces for runners 12 in. long, ⅝ in. square.

Screw.—Buy a 12 in. × ⅝ in. iron screw, square threads and plate nut. Mortise two ⅝ in. square holes in the right-hand piece of wood; clamp the two pieces together and mark for the other holes; mortise these; fix the guides in the right-hand piece so as to be a sliding fit in the left-hand piece. Put the two together, cramp up, and bore a hole through the two for the screw, which must slide in easily. Fix nut as in press in the left piece on the outside.

Knife.—Get the blacksmith to make a knife out of an old file or a piece of good tool steel, 3½ in. × 1 in. × ⅛ in., with two countersunk holes—the sinking for heads of the screws to be on the under side. Make a shallow mortise for the knife in the right sole and part of left sole, taking care that the knife is a good fit and lies level on face of press, with the bevelled point upwards. Use linseed oil as for the press.

BOOKS FOR REFERENCE

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